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Vulnerabilities of Ecosystem Components within the Estuary and Gulf of St. Lawrence

Hardy, M., C. Ferron, C. Mullins, J. Trottier, V. Joseph and M. Vaché

Fisheries and Oceans Canada, Gulf Region
343 Université avenue, P.O. Box 5030
Moncton, NB, E1C 9B6

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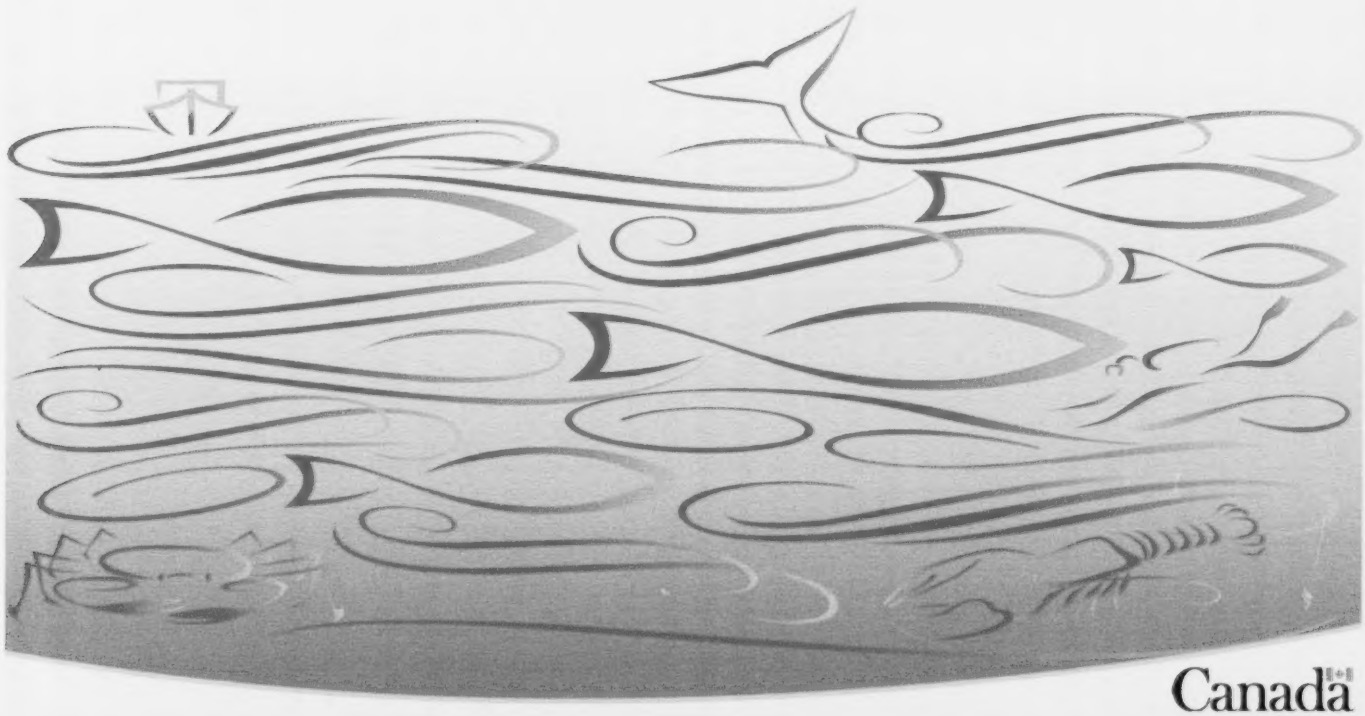

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VULNERABILITIES OF ECOSYSTEM COMPONENTS WITHIN THE ESTUARY AND GULF OF ST. LAWRENCE

2012

Hardy, M. [1], C. Ferron[1], C. Mullins[2], J. Trottier[3], V. Joseph[1] and M. Vaché[3]

[1]Fisheries and Oceans Canada,
Gulf Region
343 Université avenue, P.O. Box 5030
Moncton, NB, E1C 9B6

[2]Fisheries and Oceans Canada,
Newfoundland Region
Regent Square
Corner Brook, NL, A2H 7K6

[3]Fisheries and Oceans Canada,
Quebec Region
850, route de la Mer, C.P. 1000
Mont-Joli, QC, G5H 3Z4

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ABSTRACT

Integrated planning processes within the Estuary and Gulf of St. Lawrence are intended to help achieve a sustainable aquatic ecosystem which supports an economically prosperous maritime sectors and fisheries. The Gulf of St. Lawrence Integrated Management (GOSLIM) initiative has adopted an ecosystem-based risk management approach to identify management issues and help set priorities with relevant regulatory authorities and partners.

This report provides a qualitative analysis of a number of ecosystem components and their perceived vulnerabilities to the environmental stresses induced by human activities. The report presents profiles of 75 ecosystem components and considers the relevance of activities and stressors based on a reasonable potential for an interaction according to established parameters. Moreover, a synthesis of the vulnerabilities within five categories of environmental effects was completed in order to help define priority themes for management. The key themes of issues that emerged are: 1) Groundfish and invertebrate vulnerability to biomass removal and physical alteration of habitats, 2) Pelagic fish vulnerability to biomass removal 3) Marine mammal vulnerability to noise, entanglement, ship-strikes and contaminants, and 4) Marine plant vulnerability to biota alteration, from invasive species, contaminants and nutrient input.

This approach supports the alignment of management priorities towards effective mitigation the most severe environmental effects which threaten the prosperity within the Estuary and Gulf of St. Lawrence.

RÉSUMÉ

Les processus de planification intégrée dans l'estuaire et le golfe du Saint-Laurent ont pour but d'atteindre la durabilité des écosystèmes aquatiques afin d'assurer des secteurs maritimes et des pêches économiquement prospères. Dans le cadre de la gestion intégrée du golfe du Saint-Laurent (GIGSL), une approche de gestion des risques basée sur l'écosystème a été adoptée pour identifier des enjeux de gestion et afin d'aider à l'établissement des priorités avec les autorités réglementaires compétentes et les partenaires.

Ce rapport présente une analyse qualitative des vulnérabilités potentielles de plusieurs composantes de l'écosystème du Saint-Laurent aux activités humaines qui s'y déroulent. Il présente 75 composantes de cet écosystème et considère la pertinence des activités et facteurs de stress basée sur un potentiel raisonnable d'interactions selon des paramètres établis. De plus, une synthèse a été réalisée pour regrouper les vulnérabilités selon cinq catégories d'effets environnementaux afin de mieux définir des thèmes prioritaires pour la gestion. Les thèmes des enjeux relevés sont : 1) Vulnérabilité des poissons de fond et des invertébrés benthiques aux prélèvements de biomasse et à l'altération des habitats, 2) Vulnérabilité des pélagiques aux prélèvements de biomasse, 3) Vulnérabilité des mammifères marins au bruit, dérangements, collisions et contaminants et 4) Vulnérabilité des plantes marins à l'altération du biote, les espèces envahissantes, les contaminants et l'apport de nutriments.

Cette approche est conçue pour guider les actions de gestion afin de prioriser l'atténuation efficace des effets écologiques qui menacent la prospérité de l'écosystème de l'estuaire et le golfe du Saint-Laurent.

1.0 INTRODUCTION

Integrated Management (IM) is one of the three guiding principles of the *Oceans Act*. It is recognized as a practical approach to planning and managing human activities in a comprehensive manner while considering the conservation, protection and sustainable development of marine resources and spaces.

Under the Oceans Action Plan (OAP), the Canadian Government established five Large Ocean Management Areas (LOMA) as priority areas for the development and implementation of IM plans. The Gulf of St. Lawrence Integrated Management (GOSLIM) LOMA is one of these priority areas. This LOMA encompasses the Gulf of St. Lawrence and the St. Lawrence Estuary (hereafter referred to as Gulf of St. Lawrence) is coordinated by three Fisheries and Oceans Canada (DFO) Regions – Gulf Region, Newfoundland and Labrador Region, and Quebec Region.

In the Gulf of St. Lawrence, there are numerous human activities which can each induce stress on species living and on their habitats. The integrity of the biota and the habitats which have a major role in ecosystem structure and function (DFO 2009a) contribute to the socio-economic and cultural characteristics of the region which depend on the ecological goods and services derived from the marine environment.

The integrated planning for the Gulf of St. Lawrence takes an ecosystem-based risk management approach which is designed to identify and align management actions to address the most severe effects on the ecosystem. This approach is meant to identify where management measures are needed to achieve the effective mitigation of environmental effects that threaten the prosperity of specific areas within the Gulf of St. Lawrence and as a whole.
The purpose of the present work is to support integrated planning for the Estuary and Gulf of St. Lawrence and to provide direction by highlighting the potential issues which are deemed to pose greater risks to the biota and habitats within the LOMA.

This report provides an analysis of a number of individual marine ecosystem components and their perceived vulnerabilities to the stresses induced by human activities. It also aims to provide a synthesis of the cumulative nature of these activities and stresses by grouping them into categories of related environmental effects.

The analysis aims to attain the following objectives:

- Refine a list of ecosystem components (i.e. species, groups of species, and functional categories) which were deemed relevant to the GOSLIM conservation objective.
- Provide a summary profile to serve as a reference for each ecosystem component listed and describe the key activities and stressors which are deemed to pose greater risks.
- Compile activities and stressors from each ecosystem component analysis in order to understand their prevalence in the Gulf of St. Lawrence.
- Categorize the types of effects associated with activities and stressors in order to understand the cumulative potential for environmental effects.

2.0 ECOSYSTEM-BASIS FOR ANALYSIS

This section describes the information basis that was developed through DFO's Canadian Science Advisory Secretariat (CSAS) scientific peer-review processes in support of GOSLIM. These DFO Science advisory processes identified the "significant" components in the ecosystem to aid in the development of conservation objectives that will guide the management of human activities in a sustainable manner.

This scientific information was then used to identify the vulnerabilities of ecosystem components to human activities. The analysis also required an extensive review of peer-reviewed literature, grey literature and the development of a conceptual analysis framework (see Methodology section 3.0).

2.1 Ecologically and Biologically Significant Areas

Prior to the current analysis, DFO identified ten Ecologically and Biologically Significant Areas (EBSAs) in the Estuary and Gulf of St. Lawrence, using nationally developed guidelines (Figure 1; DFO 2007c; DFO 2009a). These ten EBSAs cover 77,184 km² (i.e. 30% of the Estuary and Gulf of St. Lawrence). They were identified using maps created by geo-referencing available biological data. In this approach, a relative value was assigned to significant areas for each of the biological layers (primary production, secondary production, meroplankton, benthic invertebrates, pelagic fish, and groundfish and marine mammals). The value of each significant area, based on the EBSA criteria, was given according to 1) its uniqueness, 2) the concentration of the biological component in the area and 3) the function of the area relative to the ecological component (DFO 2004a). Guidance criteria were developed and validated through the Canadian Science Advisory Secretariat process for the identification of EBSA as well as Ecologically Significant Species (ESS) and Community Properties (DFO 2004a; DFO 2006 a, b, c). Additional guidance was established for the development of conservation objectives within each Large Ocean Management Area (DFO 2007a; DFO 2007b).

The identification of EBSA is "*not a general strategy for protecting all habitats and marine communities that have some ecological significance. Rather, it is a tool for calling attention to an area that has particularly high Ecological or Biological Significance, to facilitate provision of a greater-than-usual degree of risk aversion in management of activities in areas of especially high ecological and biological significance*" (DFO 2004a).

It is important to note that at the time of the EBSA identification and validating process for the Gulf of St. Lawrence LOMA, it was not considered feasible to include coastal areas (approximately < 30 m depth) in the analysis due to the additional complexity and the availability of information. As such, the ten EBSAS currently identified for the Estuary and Gulf of St. Lawrence do not include coastal zones elements and coastal issues.

Through the scientific peer review process, one unique conservation objective was defined for the ten EBSAs in the Estuary and Gulf of St. Lawrence:

> *"Ensure that the features of the EBSA related to its uniqueness, which make the area appropriate for aggregation and / or that ensure the reproduction and survival of the dependant species in that area (fitness consequences), are not altered by human activities* (DFO 2009a, p. 2)".

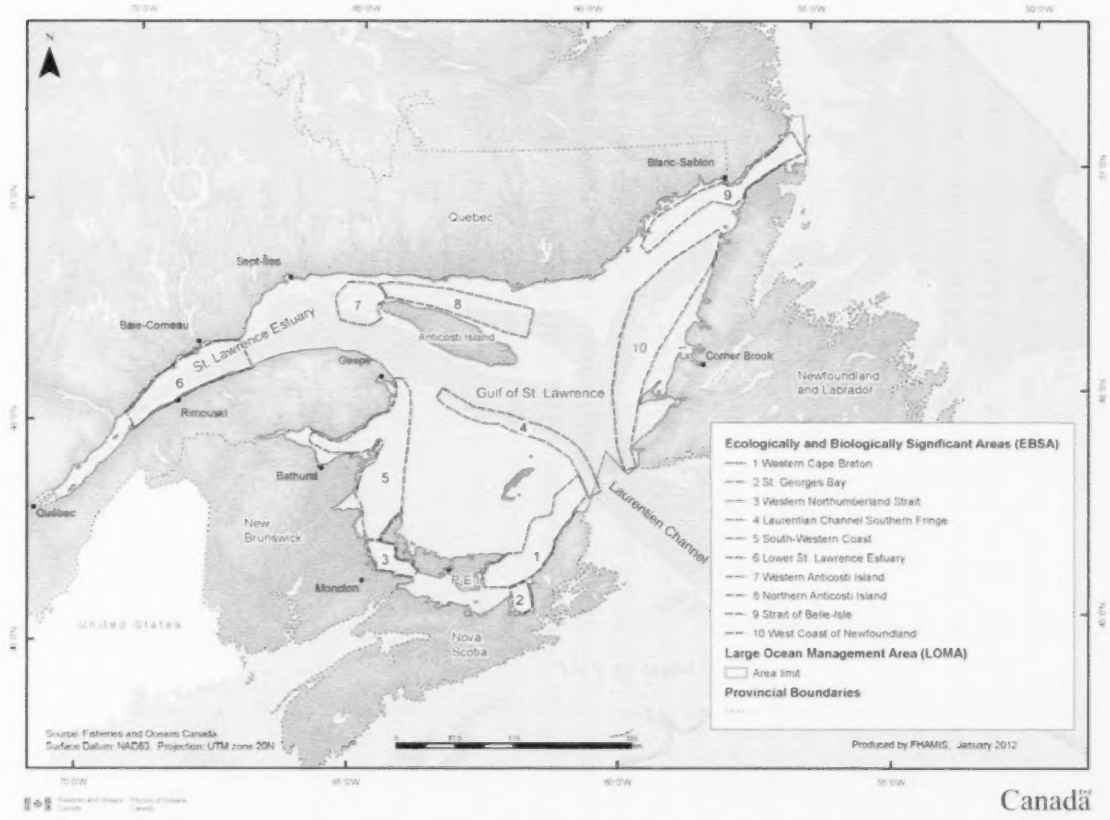

Figure 1: Map of the Estuary and Gulf of St. Lawrence showing the ten previously identified Ecologically and Biologically Significant Areas (EBSA) (adapted from (DFO 2009a)).

2.2 Candidate Ecologically Significant Species

Similarly to the EBSAs, the definition of Ecologically Significant Species (ESS) and Community Properties is meant to "*...facilitate provision of a greater-than-usual degree of risk aversion in management of human activities that may affect such species or community properties...*" (DFO 2006c). Area extent of the ESS is larger than the EBSAs and includes coastal areas. In the Estuary and Gulf of St. Lawrence, only one species has been validated as an ESS to date: eelgrass (*Zostera marina* L.) (DFO 2009b). This validation requires a comprehensive scientific review, using the national guidelines (DFO 2006b).

The scientific review process to identify all of the ESS in the Estuary and Gulf of St. Lawrence has not yet been completed. According to DFO scientists, 22 additional species have sufficient data to go through the validation process (DFO, unpublished). These species are referred to as Candidate Ecologically Significant Species (CESS) in this report as they are pending validation as Ecologically Significant Species. It is expected that when the science review process is complete, these and other species may be validated as Ecologically Significant Species.

3.0 METHODOLOGY

A risk-based approach was applied to assess the vulnerabilities of key ecosystem components to human activities. Vulnerability implies an inherent susceptibility of an ecosystem component in relation to the potential effects of a hazard which can cause adverse consequences. Vulnerability takes into account both the effect of exposure on an ecosystem component and the likelihood of exposure.

The risk-based approach involved the consideration of the likelihood of interactions between key ecosystem components and human activities as well as an appreciation of the potential consequences stemming from these interactions. Conceptually, the Driver-Pressure-State-Impact-Response (DPSIR) was considered for informing the categorizing information and in developing an understanding the causal relationships between activities and their potential effects.

The framework used to evaluate the vulnerabilities of the ecosystem components was adapted from the approach used in the Placentia Bay/Grand Banks (PBGB) Large Ocean Management Area (Park *et al.* 2010). The PBGB approach involved a quantitative assessment of the risk of harm posed by key activities and related stressors on valued ecosystem components. This quantitative approach was adapted to serve the required purposes in the Estuary and Gulf of St. Lawrence Large Ocean Management Area.

The general approach used for vulnerabilities identification involved a four-step analysis illustrated in Figure 2.

3.1 Ecosystem components and human activities

The ecosystem components used in this report were identified through DFO scientific advisory processes. The 75 components identified do not represent a definitive list of all significant components of the ecosystem; they are however deemed to be representative of many significant species, species groups, and functions represented in the Estuary and Gulf of St. Lawrence.

EBSA and CESS components were evaluated in two separate work phases (Figure 2). They will be referred separately through much of this report because of differences in the peer-reviewed status of the components, and differences in their data availability and resolution (the spatial scale of the nature of the component groups). However, the separate work phases are complementary because the CESS components are widely distributed in the gulf and include coastal species. As such, CESS components complete the ecological profile provided by EBSA components.

3.1.1 EBSA Components

The CSAS Science Advisory Report for the EBSA (DFO 2009a) provided a list of key characteristics or general conservation priorities for each EBSA identified for the GOSLIM LOMA. It included descriptions of species or groups of species which were deemed to be relevant to the functional characteristics described for the ten EBSAs

Based on the list of conservation priorities provided for the EBSA (DFO 2009b) a total of 52 EBSA ecosystem components were derived from the report and included in this analysis. For a complete list of the 52 selected EBSA components, refer to appendix B1- B52 titles.

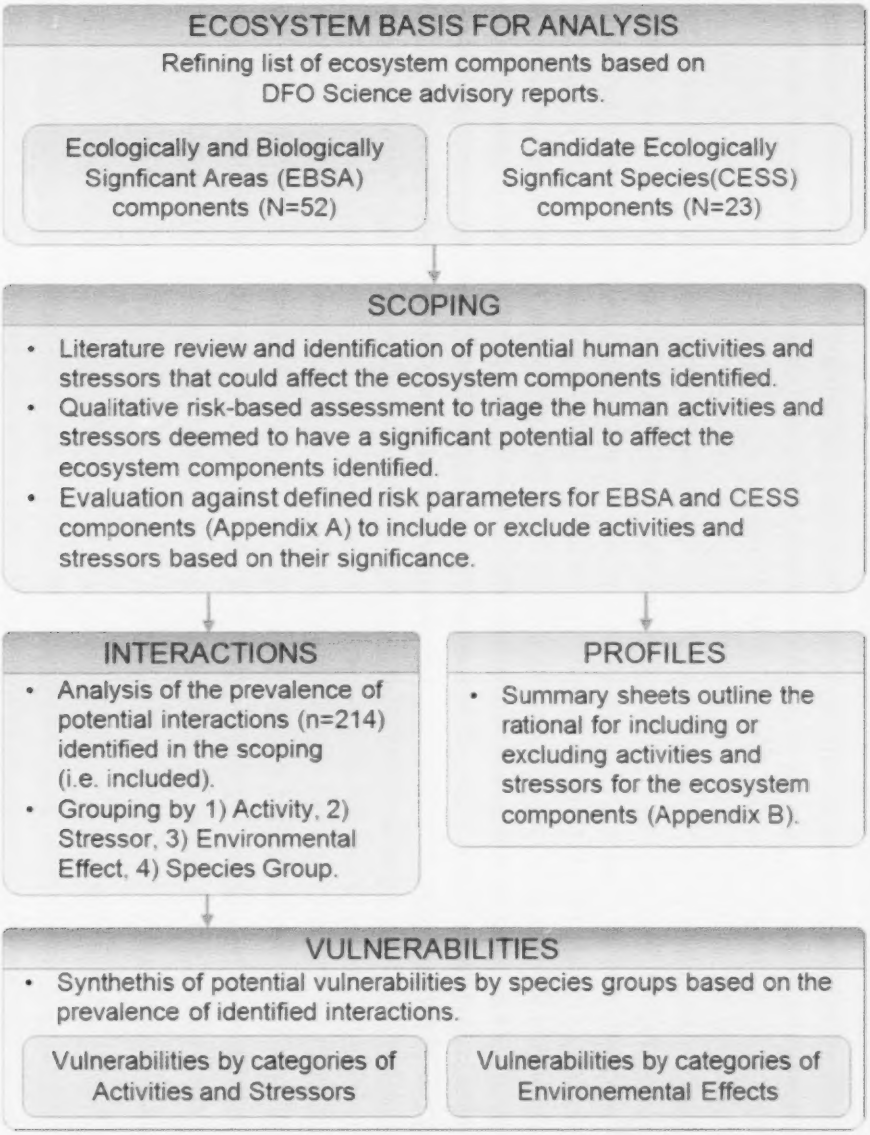
ECOSYSTEM BASIS FOR ANALYSIS
Refining list of ecosystem components based on DFO Science advisory reports.
Ecologically and Biologically Signficant Areas (EBSA) components (N=52)
Candidate Ecologically Signficant Species(CESS) components (N=23)
SCOPING
• Literature review and identification of potential human activities and stressors that could affect the ecosystem components identified.
• Qualitative risk-based assessment to triage the human activities and stressors deemed to have a significant potential to affect the ecosystem components identified.
• Evaluation against defined risk parameters for EBSA and CESS components (Appendix A) to include or exclude activities and stressors based on their significance.
INTERACTIONS
• Analysis of the prevalence of potential interactions (n=214) identified in the scoping (i.e. included).
• Grouping by 1) Activity, 2) Stressor, 3) Environmental Effect, 4) Species Group.
PROFILES
• Summary sheets outline the rational for including or excluding activities and stressors for the ecosystem components (Appendix B).
VULNERABILITIES
• Synthethis of potential vulnerabilities by species groups based on the prevalence of identified interactions.
Vulnerabilities by categories of Activities and Stressors
Vulnerabilities by categories of Environemental Effects

Figure 2: Synopsis of the Vulnerability Analysis

3.1.2 CESS Components

A total of 23 species were deemed to have sufficient data to be considered as CESS (see appendix B53 – B75). Among those, only one, eelgrass, went through evaluation process and became an ESS. Despite the fact that the other 22 CESS are still pending validation, they have been included in the list of potentially vulnerable Ecosystem Components in the Estuary and Gulf of St. Lawrence. For easier reading of the report, Eelgrass is included in the list of CESS even though it has been validated.

3.1.3 Human activities

A wide array of activities and associated stressors (Table 1) were considered within the context of this analysis based on the existing literature (Alexander *et al.* 2010; Park *et* al. 2010; Dufour and Ouellet 2007) and consultation with various Science and Fisheries and Aquaculture Management personnel within DFO.

In addition, a number of databases were accessed in order to evaluate the geospatial distribution of human activities versus the ecosystem components (species or group of species) distribution:

3.1 Scoping

Scoping consisted in the identification of current human activities and related stressors that are deemed to potentially affect a given ecosystem component (EBSA or CESS components). Scoping is a qualitative assessment leading to inclusion of higher risks activities/stressors for into further analysis (and exclusion of others). The scoping is based on risk parameters which differed for EBSA (Table 3) and CESS ecosystem components (Table 4).

In deciding whether to include or exclude an activity/stressor in the final analysis the authors made the determination of the potential "significance of effects" on a given ecosystem component. This represented an exercise judgment in distinguishing between the potential for negligible and non-negligible environmental effects. This subjective judgment was based on the best available knowledge and data for the Estuary and Gulf of St. Lawrence and authors' expert opinion. Definitions which were adapted from the Canadian Environmental Assessment Agency's replacement class screening report (Canada 2007) served as a benchmark in determining significance:

> "**Significant* [environmental effects]**" – A residual environmental effect is considered significant when it induces frequent, major levels of disturbance and/or damage and when the effects last longer than a year and extend beyond the boundary of the [activity] despite management or mitigation measures. It is either reversible with active management over an extended term or otherwise irreversible.
>
> "**Not Significant [environmental effects]**" – A residual environmental effect is considered not significant when it has infrequent, minor or negligible levels of disturbance and/or damage and when the effects last less than a year and are contained within the boundary of the [activity] following the application of management or mitigation measures. An effect that is not significant is reversible with or without short-term active management.

The parameters in Tables 3 and 4 were adapted from Park *et al.* (2010), a qualitative analysis (ranking) of the risks to ecosystem components and properties in the Placentia Bay/Great Banks LOMA. These parameters described the magnitude of interaction between a key ecosystem component and a potentially harmful activity/stressor as well as the sensitivity or the degree to which an adverse effect may result from an interaction with the activity or stressor. For the purpose of the GOSLIM initiative, a qualitative assessment of the potential interaction between a given ecosystem component and an activity/stressor was done, without any ranking.

According to each risk parameter, the authors identified key human activities and associated stressors that have or may have the potential to significantly impact each of the 75 ecosystem components. Based on an extensive review of recent scientific research and on experts' opinion, the physical interaction (contact, areal extent, duration, etc.) of the activities/stressors

Table 1: Types of activities and stressors considered in the vulnerability analysis.

Activities	Stressors
Bottom trawl	Biomass removal
Scallop dredge	Habitat alteration
Clam dredge	Current obstruction
Midwater trawl	Noise/Disturbance
Gillnet (bottom)	Ship strikes/Collisions
Gillnet (pelagic)	Entanglement
Longline	Marine debris (litter)
Scottish/Danish seine	Ghost nets
Purse seine	Oil spills/ pollution
Recreational cod fishery	Persistent organic
Crab pots	Industrial effluent
Lobster pots	Fish plant offal
Whelk pots	Nutrient input
Hand line	Sedimentation
Jigging machine	Oxygen depletion
Mackerel trap	Change in freshwater input
Other fishing gear	Toxic algal blooms
Seal hunt	Parasites/ diseases
Seaweed harvest	Ocean acidification
Fish processing	Ice distribution
Dredging	Temperature/ salinity change
Aquaculture	Sea-level rise
Sub-marine cables	Change in ocean currents
Freshwater diversion/dams	Increased storms/surges
Marine construction (ex. Dykes,	Increased UV radiation
Coastal infrastructure/ construction	Invasive species
Ecotourism	
Vessel traffic	
Ballast water exchange	
Seismic surveys	
Industrial activities	
Human settlement	
Human activity-induced climate	

with each ecosystem component, the acute and chronic impacts of the activity/stressor on each component, the ecological importance of the component within the ecosystem and its degree of resilience were determined. This qualitative information was used to determine whether an activity/stressor has the potential to have caused a significant effect within the last 10 years or has the potential to cause a significant effect within the next 10 years on each ecosystem component.

For EBSA components, the determination for inclusion or exclusion of interaction with activities and stressors was qualitatively evaluated by considering the Magnitude of Interaction and the

Table 2: List of databases consulted for the analysis.

Databases Consulted
Northern Gulf of St. Lawrence multidisciplinary groundfish and shrimp survey (CCGS Teleost)
Southern Gulf of St. Lawrence September bottom trawl survey (CCGS Teleost)
Northern Gulf of St. Lawrence snow crab survey
Southern Gulf of St. Lawrence snow crab survey
Compilation of fishermen logbook data (DFO)
Sentinel survey by mobile and fixed gear
Northumberland Strait multi-species survey (lobster)
Fish habitat management information system (FHMIS)

Table 3: Description of risks parameters considered for the scoping of an activity/stressor given its potential for interaction with an EBSA component.

Risk Parameters	Description
Magnitude of Interaction (MOI)	
Areal Extent	Likelihood of spatial overlap (distribution of activity & component)
Contact	Likelihood of direct physical interaction
Duration	Likelihood of temporal overlap
Intensity	Likelihood of repeated interactions (frequency)
Sensitivity (S)	
Acute Impacts	Level of impact on the component
Chronic Impacts	Level of cumulative impacts on the component
Ecosystem Sensitivity to impacts on the Component	Level of importance of the component to the ecosystem.

Table 4: Description of risk parameters considered for the scoping of an activity / stressor given its potential for interaction with a CESS component.

Risk Parameters	Description
Magnitude of Interaction (MOI)	
Areal Extent	Likelihood of spatial overlap (distribution of activity & CESS)
Contact	Likelihood of direct physical interaction
Duration	Likelihood of temporal overlap
Intensity	Likelihood of repeated interactions (frequency)
Sensitivity (S)	
Severity of impact	Level of impact on species/habitat
Ecological Importance	Level of importance of the species to the ecosystem
Resilience	Ability of species to recover from perturbation

Sensitivity criteria presented in Table 3 (modified from Park *et al.* 2010). This approach was deemed sufficient for the required application in the Estuary and Gulf of St. Lawrence given inconsistencies in data availability required for quantitative ranking components as per Park *et al.* (2010). Challenges were most prominent with respect to the "Areal Extent" criteria and the diversity in the species or groups of species represented within each description.

For CESS components, the challenges were encountered in regard to summarizing information on the potential vulnerability to activities and stressors based on their Estuary and Gulf-wide distribution. In comparison to EBSA components, information was more accessible due to the fact that most species are of commercial interest. The criteria used to evaluate Magnitude of Interaction and Sensitivity of the CESS to activities and stressors (Table 4) were similar to those for EBSA. The only exception was that acute and chronic impacts were combined into a single parameter called Severity of Impact and a parameter for Resilience was added.

So, during the scoping exercise, Activities and stressors judged to have a negligible potential for interaction were excluded from further consideration for the analysis. Only those with a non-negligible potential for interaction were considered to be 'included' for further consideration leading to vulnerabilities determination.

Profile sheets (Ecosystem Component Profiles) were completed to summarize the information examined for each of the 75 Estuary and Gulf of St. Lawrence ecosystem component and associated activities/stressors. The profiles list the scoping process results (i.e., the activities/stressors initially considered) and among them the included (Y for yes) or excluded (N for no) activity/stressor. They also offer a short justification explaining the reasons for their inclusion or exclusion. In addition, the profiles provide some details on the biology and distribution of a given ecosystem component in order to serve as reference piece.

For the CESS ecosystem components only, the profiles also contain a relative risk graph for each of the 23 important species for the Estuary and Gulf of St. Lawrence (Appendix A). The Gulf-wide data availability for CESS components allowed us to conduct a separate but complementary analysis to the scoping process and vulnerability analysis. The relative risk posed by all the selected activities/stressors per CESS component was assessed using a ranking process.

3.2 Prevalence of Interactions

The scoping analysis resulted in a number of activities and stressors which were considered to have the potential to affect ecosystem components (i.e. included), as listed in the profiles (Appendix B). The interaction counts were completed separately for EBSA and for CESS components. Due to varying levels of data quality/certainty for the risk parameters it was deemed inappropriate to weight the relative risk in the determination of vulnerabilities.

The analysis of the prevalence of interactions served as the basis for assessing vulnerabilities by categories of activities and stressors as well as by the categories of environmental effects.

The analysis consisted of excel-based pivot-table calculations of the 214 identified interactions which were categorized (Table 5) according to 1) Activity, 2) Stressors, 3) Environmental Effect, 4) Species Group.

Ecosystem components stemming from EBSAs and CESS were collated into functional groups in relation to species group (Table 6). Groupings for each ecosystem component were based directly on the descriptions provided in the Science Advisory Report (DFO 2009a); for example "Appendix B25 – EBSA 5: Features of south-western coast of the Gulf: Shelter, feeding and spawning for pelagic fish (southern Gulf herring, alewife, spiny dogfish, capelin, mackerel, rainbow smelt)".

3.3 Vulnerabilities to Activities and Stressors

Quantitative statistics were not deemed to be appropriate given the qualitative nature of this exercise. No attempt has been made to try to infer a statistical significance to the information presented below.

Ecosystem components usually are vulnerable to more than one stressor at the same time and the same stressor could be induced by several different activities. As such, vulnerabilities in table 8 have been inferred from the highest frequency of potential interactions between ecosystem components, grouped into species categories, and a given stressor (that might stem from one activity or more see table 5). The frequency varied largely because certain species groups were perceived to be influenced by a greater number of activities/stressors, often because of their proximity to human activities.

3.4 Vulnerabilities to Environmental Effects

In many cases, activities/stressors were considered to have the potential to interact with ecosystem components in similar ways (same type of environmental effects) (Table 5). For example, marine construction, dragging and dredging can all have effects on benthic marine habitats structure. However, the specific levels of effect will vary but can be additive or cumulative.

The types of environmental effects associated to the activities/stressors have been grouped by the following five broad categories:

- **Biota Alteration** – Changes in the ecological structure, diversity or abundance of species within the area which can affect the functions of the ecosystem beyond the range of natural variability (i.e. selective removal of specific groups of species, introduction of invasive species, direct mortality, etc.).

- **Contamination** – Introduction of substances, waste or pathogens which are deleterious to a species or to the human consumption of the species (e.g., heavy metals, hydrocarbons, diseases, bacterial contamination, etc.).

- **Habitat alteration** – Physical alteration of the structure of a habitat which can compromise its integrity and affect its ability to support species their life stages (e.g., structural changes of habitat such as dredging, direct loss of habitat through construction of marine infrastructure, etc.).

- **Habitat disruption/fragmentation** – Disruption of habitat which renders it less suitable to species habitation. Organisms can be effectively excluded from an area or the area remains inaccessible to species due to an antagonism (e.g., noise and disturbance caused by vessel traffic).

- **Nutrient/sediment regime alteration** – Changes in the physical and chemical nature of habitat beyond the range of natural variability. The alteration of the nutrient or sediment regime can induce trophic consequences and/or effect on the water quality (e.g., primary production changes, anoxic events, smothering and turbidity alterations).

Significant interactions between activities/stressors and ecosystems components were also grouped by categories of environmental effects.

These categories identify types of similar environmental effects on a given species or group of species which may arise from different activities and stressors (Table 5). The use of environmental effects categories is consistent with other integrated risk management frameworks (Hardy and Cormier 2008).

It should be noted that the categories are not representative of a regulatory interpretation of the potential effects (i.e. *Fisheries Act* Habitat provisions for harmful alteration, disruption or destruction of fish habitat). These categories are limited to the scope of the aquatic context of this analysis.

Table 5: Categories of environmental effects associated to activities and stressors for all the identified ecosystem components in the analysis.

Activities	Stressors	Environmental Effects
Bottom Trawl	Biomass Removal	Biota Alteration
Danish/Scottish Seine		
Gillnet		
Handline		
Jigging		
Longline		
Pots and Traps		
Purse Seine		
Scallop Dredge		
Trawl		
Tuck Seine		
Gillnet	Ghost Fishing Mortality	
Pots and Traps		
Ballast water exchange	Introduction of Invasive Species	
Recreational Activities	Ship-Strike Mortality	
Vessel Traffic		
Industrial activities	Industrial Effluent	Contamination
Vessel Traffic	Oil Spills and pollution	
Bottom Trawl	Physical Alteration of Habitat	Habitat Alteration
Dredging		
Gillnet		
Longline		
Marine Construction		
Pots and Traps		
Scallop Dredge		
Gillnet	Entanglement	Habitat Disruption / Fragmentation
Pots and Traps		
Recreational Activities	Noise & Disturbance	
Seismic		
Vessel Traffic		
Human Settlement	Nutrient Input	Nutrient Regime Alteration

4.0 RESULTS

4.1 Key Activities and Stressors

The ecosystem component profiles provide a brief description of the primary potential issues that may affect each ecosystem component and could be relevant guidance to management. Profiles were prepared for a total of 75 ecosystem components including 52 EBSA-based and 23 CESS-based ecosystem components (See appendix B1-B75).

The stressors associated with human climate change have not been retained in this assessment because of insufficient time series data to detect clear trends, or because of difficulty in explaining inter-annual variations in the data.

For each ecosystem component, a number of activities/stressors interactions were deemed to have a potentially significant effect. This varied largely between ecosystem components because certain species groups were perceived to be influenced by a greater number of activities/stressors, often because of their proximity to human activities.

4.1.1 Activities and stressors - EBSA Components

The Appendices B1 to B52 refer to the profiles of the 52 EBSA components (species or group of species) according to their EBSA number. In each profile, results of the scoping of activities and stressors are presented in a matrix form in order to represent their potential of interaction. In the matrix, "Y" represents an important interaction deemed to occur between a higher risk activity / stressor and a given ecosystem component. "N" represents a rejected or screen out activity/stressor because of its negligible potential for interaction with an ecosystem component. The determination to include or exclude an activity (and its potential interaction) is explained for each EBSA ecosystem component.

4.1.2 Activities and stressors - CESS Components

The Appendices B53 to B75 refer to the profiles for the 23 CESS components. Given the availability of information, the profiles developed for the CESS have more details. For CESS components, a short description on the biology/distribution is provided with a graphical illustration of the relative risk posed for on a species by each of the activities/stressors based on hazard levels (see Appendix A).

4.2 Prevalence of Interactions

This section represents an analysis to summarize all the individual assessments on the EBSA components and the CESS components. For the 52 EBSA components 107 ecosystem-component/stressor potential interactions were identified, while an additional 107 potential interactions were identified for the CESS components for a total of (n=214) potential interactions identified between human activities and key ecosystem.

The EBSA components are represented in Table 6 by five species group (groundfish, invertebrates, marine mammals, pelagic fish and plankton) and nine categories of stressors. Given that the descriptions from which the EBSA components were derived (DFO 2009a) included arrays of species and groups of species, an attempt was made to group the ecosystem components in terms of their functional group. Moreover, a descriptor of the characteristics of the ecosystem components was attributed based on the parameters, which were deemed to be the most representative, from the EBSA guidance (DFO 2004a): Uniqueness, Aggregation, Fitness Consequences.

Table 6: List of the functional groups of EBSA components categorized by species group, with their corresponding EBSA number (Figure 1) and the respective appendix numbers as well as counts of stressor interactions. A total of 107 ecosystem component/stressor interactions where included in the analysis for the 52 EBSA ecosystem components.

Species Group	EBSA Components by Functional Group	Appendix B Number	Stressors	EBSA Number	Count
Groundfish	Groundfish-Aggregation	50	Oil Spills and Pollution	10	1
	Groundfish-Fitness Consequences	5, 10, 17, 34, 37, 46,	Biomass Removal	1, 2, 4, 10	7
			Nutrient Input	2	1
			Physical Alteration of Habitat	7, 8	6
	Groundfish-Migration	4, 18, 51	Biomass Removal	1, 4, 10	8
Invertebrates	Benthic Invert.-Aggregation	23, 36, 39, 41	Biomass Removal	5, 8, 9	4
			Ghost Fishing Mortality	5, 7, 8	4
			Physical Alteration of Habitat	5, 7, 8, 9	13
	Benthic Invert.-Unique Species	12	Biomass Removal	3	1
			Physical Alteration of Habitat	3	1
Marine Mammals	Marine Mammal - Aggregation	7, 40, 44, 45	Entanglement	1, 8, 9	5
			Ghost Fishing Mortality	8	2
			Noise and Disturbance	1, 8, 9	5
			Ship-Strike Mortality	1, 8, 9	5
			Oil Spills and Pollution	8	1
	Marine Mammal-Unique Habitat	30	Industrial Effluent	6	1
			Entanglement	6	1
			Ghost Fishing Mortality	6	1
			Noise and Disturbance	6	3
			Ship-Strike Mortality	6	2
			Oil Spills and Pollution	6	1
	Marine Mammal-Fitness Consequences	26, 31, 52	Entanglement	5, 6, 10	6
			Ghost Fishing Mortality	5, 6	4
			Noise and Disturbance	5, 6, 10	7
			Ship-Strike Mortality	5, 6, 10	5
			Oil Spills and Pollution	5, 6	2
Pelagic Fish	Pelagic-Aggregation	43	Biomass Removal	9	1
	Pelagic-Fitness Consequence	9, 16, 24, 25, 42	Biomass Removal	2, 4, 5, 9	8
Plankton	Meroplankton-Fitness Consequences	8	Nutrient Input	2	1
				Total	**107**

The CESS components and the list of the 10 stressors which were deemed to have the potential for significant environmental effects are represented in Table 7. The CESS analysis attempted to consider the distribution of the species relative to the distributions of human activities from an

Estuary and Gulf-wide perspective. The 23 CESS components were categorized into seven species groups (groundfish, invertebrates, cetaceans, pinnipeds, pelagic fish, plankton and marine plants). This differed slightly from the species groups used in the EBSA component analysis. For the CESS components, it was possible to separate marine mammals into cetaceans and pinnipeds. Marine plants were also included in this analysis.
Counts and frequencies are used to express the number of times that activities and stressors were deemed sufficiently significant to be screened in or warrant inclusion in the analysis (see Appendices B).

4.1 Vulnerabilities to Activities and Stressors

The following figures represent the number of occurrences of ecosystem-component interactions with activity/stressors which were deemed to have the potential for significant environmental effects. This analysis makes no assertions with respect to the actual "impact" of any activity.

The identified occurrences of activities/stressors deemed to have the potential for significant environmental effects for all ecosystem components (i.e. EBSA and CESS components) are summarised according to their respective categories in Figure 3.

Gillnetting and vessel traffic were the two activities most frequently identified for both EBSA and CESS components followed by pots & traps and bottom trawling.

Biomass removal was the stressor most often deemed to have the potential for significant environmental effects for both EBSA and CESS components followed by physical alteration of habitat as well as noise and disturbance (Figure 4 and 5).

The most frequently identified activities and stressors which were deemed to have the potential to affect a number of ecosystem components were:

- Activities: Bottom trawling, Gillnets, Pots and Traps, Vessel Traffic.
- Stressors: Biomass removal, Noise and Disturbance, Physical Alteration of Habitat.

The diversity of activities and stressors as well as ecosystem components presents a challenge in extracting the key themes of potential issues for management. That said the ecosystem components which are identified as being most susceptible, and for which activities and stressors interaction were the most frequently identified in this analysis (Figures 4 and 5), are represented in Table 8.

The EBSA components with the greatest number (frequency) of potential stressor interactions were those associated to groundfish, marine mammals, benthic invertebrates and pelagic fish.

The CESS components with the greatest number (frequency) of ecosystem-component/stressor interactions were those associated to groundfish, marine mammals, benthic invertebrates and marine plants.

The key perceived vulnerabilities of ecosystem components to activities/stressors based on the results of this analysis, are presented in Table 8.

Table 7: List of CESS components categorized by species group with the respective appendix numbers and count of stressor interactions. A total of 107 ecosystem component/stressor interactions where included in the analysis for the 23 CESS components.

Species Group	CESS components	Appendix B Number	Stressors	Count
Cetaceans	Atlantic white-sided dolphin	73	Entanglement	1
			Noise and Disturbance	2
			Ship-Strike Mortality	1
	Fin Whales	70	Entanglement	2
			Noise and Disturbance	2
			Ship-Strike Mortality	1
	Harbour Porpoise	74	Entanglement	1
			Noise and Disturbance	2
			Ship-Strike Mortality	1
	Humpback Whales	69	Entanglement	2
			Noise and Disturbance	2
			Ship-Strike Mortality	1
	Minke Whales	63	Entanglement	2
			Noise and Disturbance	2
			Ship-Strike Mortality	1
Groundfish	American Plaice	66	Biomass Removal	4
	Atlantic Cod	62	Biomass Removal	5
	Greenland Halibut	58	Biomass Removal	2
	Redfish	71	Biomass Removal	6
	Thorny Skate	68	Biomass Removal	2
	White Hake	75	Biomass Removal	4
	Winter Flounder	67	Biomass Removal	2
Invertebrates	American Lobster	72	Biomass Removal	1
			Industrial Effluent	1
			Ghost Fishing Mortality	2
			Physical Alteration of Habitat	3
			Oil Spills and Pollution	1
	Northern Shrimp	57	Biomass Removal	1
			Oil Spills and Pollution	1
	Rock Crab	55	Biomass Removal	2
			Industrial Effluent	1
			Ghost Fishing Mortality	2
			Physical Alteration of Habitat	3
			Oil Spills and Pollution	1

Table 7 (continued): List of CESS components categorized by species group with the respective appendix numbers and count of stressor interactions. A total of 107 ecosystem-component/stressor interactions where included in the analysis for the 23 CESS components.

Species Group	CESS components	Appendix B Number	Stressors	Count
Invertebrates (cont.)	Snow Crab	56	Biomass Removal	1
			Industrial Effluent	1
			Ghost Fishing Mortality	2
			Physical Alteration of Habitat	1
			Oil Spills and Pollution	1
Marine Plants	Eelgrass	53	Industrial Effluent	1
			Introduction of Invasive Species	1
			Nutrient Input	1
			Physical Alteration of Habitat	2
			Oil Spills and Pollution	1
Pelagic Fish	Atlantic Herring	59	Biomass Removal	6
			Industrial Effluent	1
			Physical Alteration of Habitat	1
			Oil Spills and Pollution	1
	Atlantic Mackerel	61	Biomass Removal	6
			Industrial Effluent	1
			Oil Spills and Pollution	1
	Capelin	54	Biomass Removal	4
			Industrial Effluent	1
			Physical Alteration of Habitat	1
			Oil Spills and Pollution	1
Pinnipeds	Grey Seal	65	Entanglement	1
			Noise and Disturbance	2
	Harp Seal	64	Entanglement	1
			Noise and Disturbance	2
Plankton	Krill	60	Oil Spills and Pollution	1
			Total	**107**

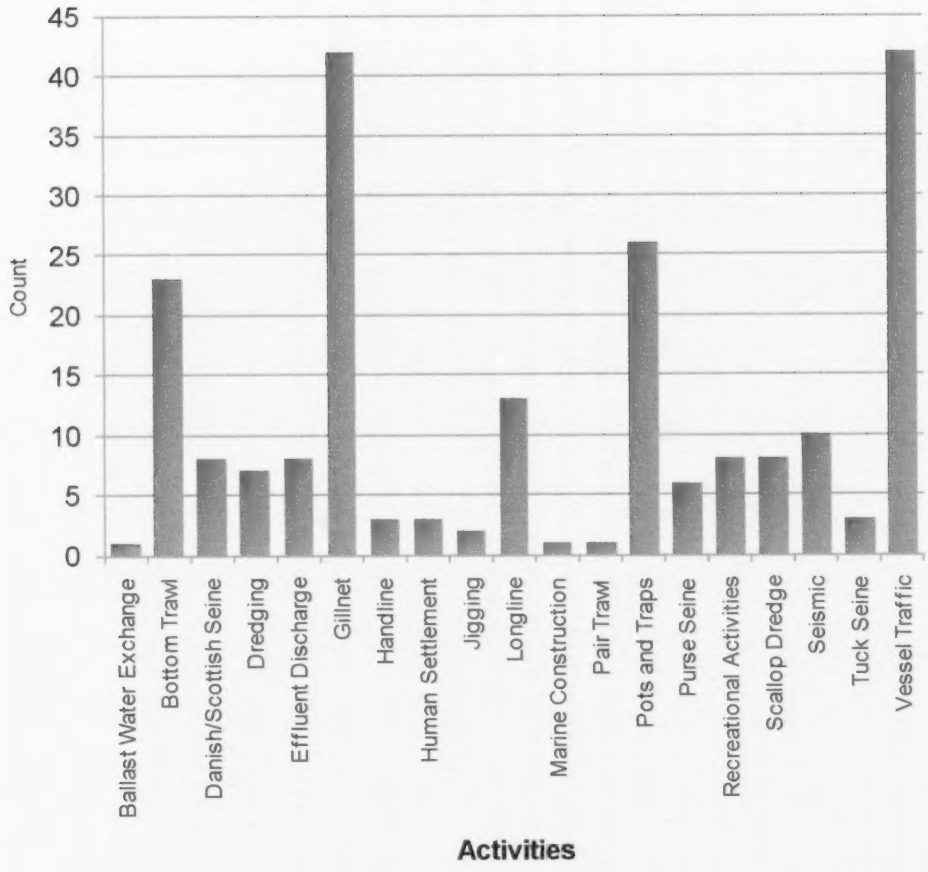

Figure 3: Frequency of ecosystem-component interactions with activities deemed to be significant for all ecosystem components [n=214].

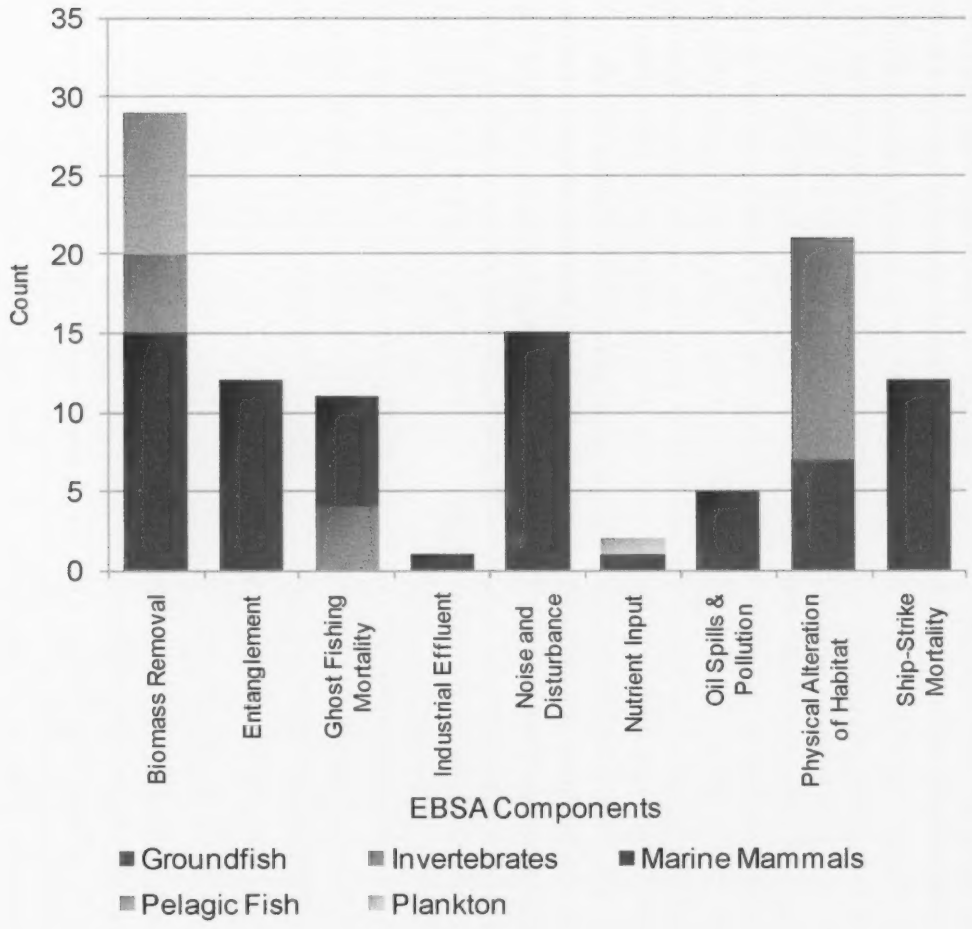

Figure 4: Frequency of ecosystem-component/stressor interactions deemed to be significant and corresponding to the categories of stressors which were identified for EBSA components [n=107].

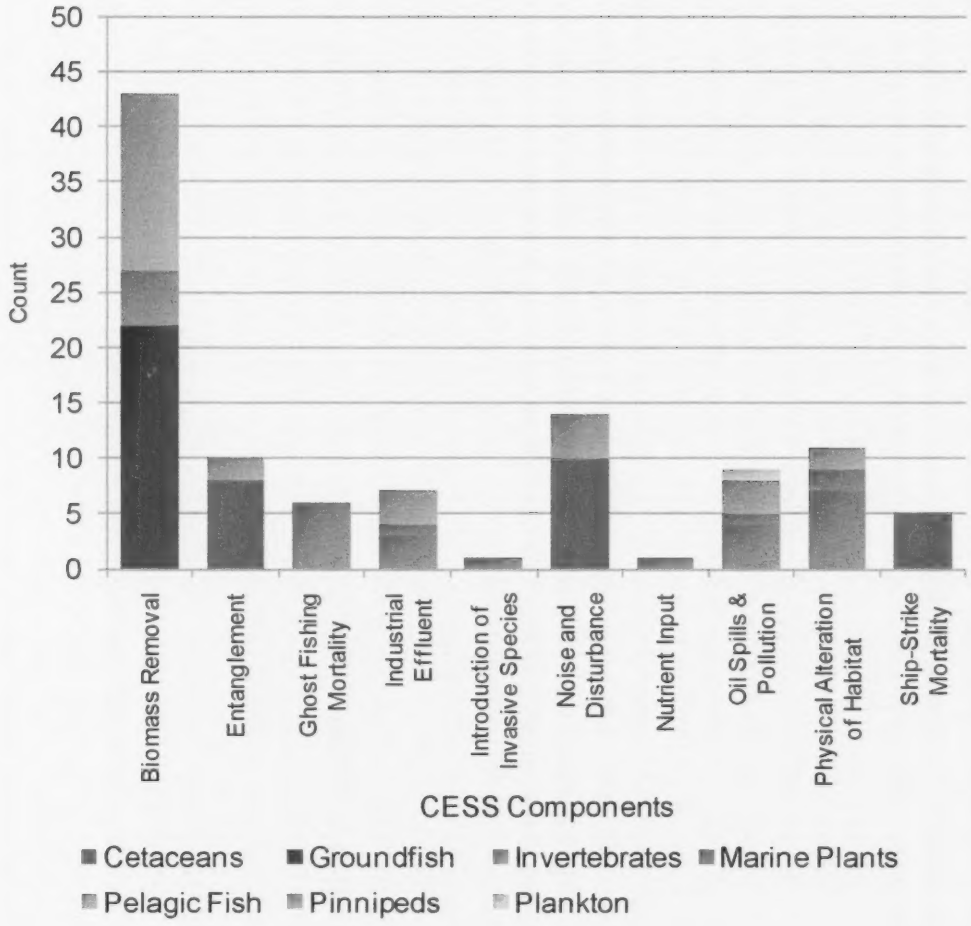

Figure 5: Frequency of ecosystem-component/stressor interactions deemed to be significant and corresponding to the categories of stressors which were identified for CESS components [n=107].

Table 8: Identified vulnerabilities of ecosystem components to activities and stressors.

Ecosystem Components	Vulnerabilities*
EBSA components	1) Groundfish vulnerability to biomass removal and physical alteration of habitats. 2) Marine mammal vulnerability to noise, entanglement, ship-strikes and contaminants. 3) Benthic invertebrate vulnerability to biomass removal and physical alteration of habitats. 4) Pelagic fish vulnerability to biomass removal.
CESS components	5) Groundfish vulnerability to biomass removal (e.g. Atlantic cod, White hake and American plaice) 6) Benthic Invertebrate vulnerability to biomass removal and physical alteration of habitats (e.g. Rock crab and Snow crab) 7) Marine mammal vulnerability to noise, entanglement, ship strikes and contaminants. 8) Marine plant vulnerability to biota alteration from invasive species, contaminants and nutrient input (i.e. Eelgrass).

* Note: These vulnerabilities are not actually deemed to be management priorities but rather are potential issues of concern. If the current regulations in place do not address them, these potential issues could be considered by regulatory authorities in the establishment of future priorities.

4.2 Vulnerabilities to Environmental effects

The synthesis of the activities and stressors within categories of environmental effects aim to bring "like-to-like" effects together. Commonalities are expected to show cumulative environmental effects that are greater than the sum of their individual effects. The environmental effects associated to the activities/stressors selected from the scoping process have been grouped by five broad categories (Table 5).

On an Estuary and Gulf-wide scale and stemming from the CESS analysis, it appears that the species groups that are most vulnerable to human activities are groundfish, cetaceans, pelagic fish, invertebrates and eelgrass (see previous section 4.3).

Figure 6 represents the frequency of potential environmental effects related to the higher risks activities/stressors for EBSA and CESS components. The CESS components also included marine plants and had distinguished pinnipeds from cetaceans.

In both cases (EBSA and CESS components) biota alteration was the most commonly identified environmental effect of concern in relation to the ecosystem components (Figure 6). This was followed by habitat disruption/fragmentation, habitat alteration, contamination, and nutrient regime alteration. Contamination was more important than habitat alteration for CESS when compared to EBSA components. This may be linked to the fact that CESS components included more nearshore species that would be vulnerable to land-based pollution and effluents.

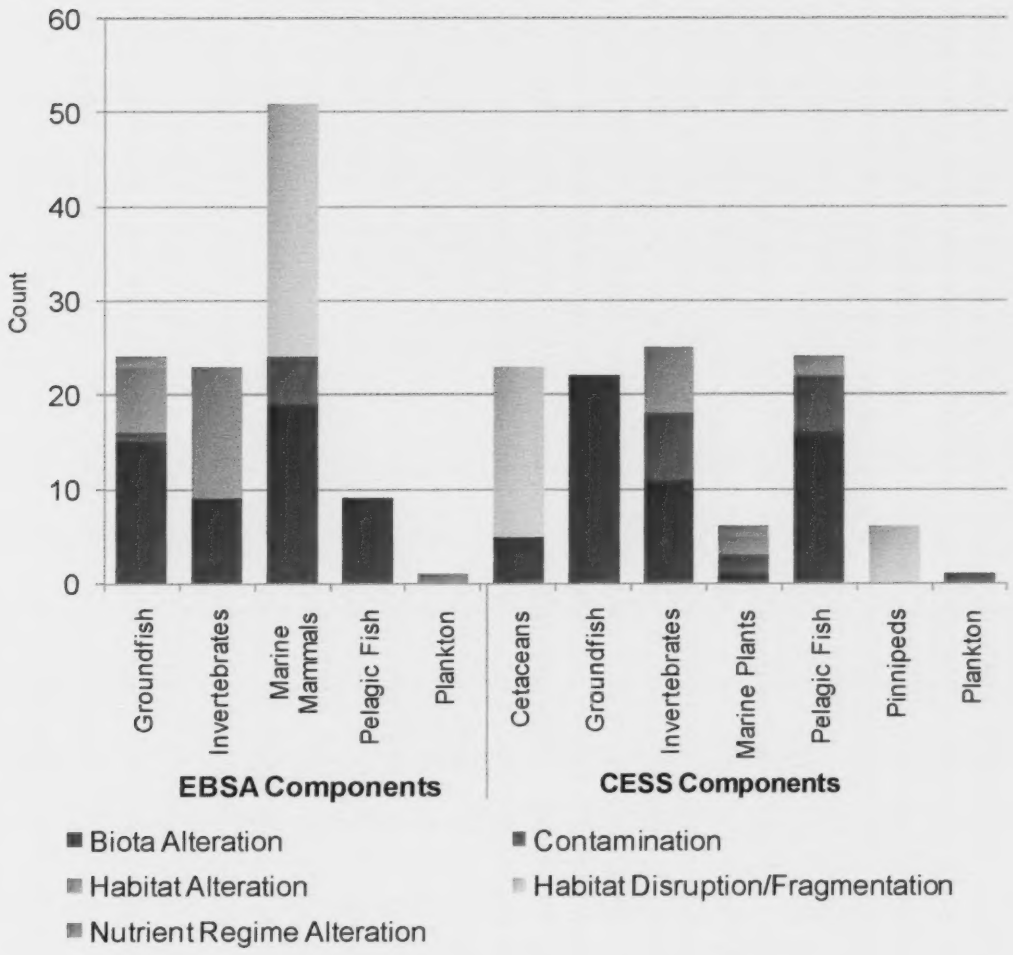

Figure 6: Frequency of ecosystem-component interactions [n=214] with activity/stressors expressed by broad categories of environmental effects.

The perceived vulnerabilities of ecosystem components to categories of environmental effects, based on the results of this analysis, are presented in Table 9. These vulnerabilities can also serve as potential themes of issues to inform integrated management planning.

Table 9: Identified vulnerable ecosystem components in relation to the categories of stressors and environmental effects considered for the analysis.

Vulnerable Ecosystem Components	Stressors	Environmental Effects
• Groundfish • Invertebrates • Cetaceans • Pelagic fish • Marine plants	• Direct biomass removal • Mortality through ghost fishing or vessel strikes • Introduction of invasive species	Biota alteration
• Groundfish • Invertebrates • Marine Plants	• Direct physical modification of habitat	Habitat alteration
• Cetaceans • Pinnipeds	• Entanglement • Noise and Disturbance	Habitat disruption/ fragmentation
• Marine Plants • Invertebrates • Cetaceans	• Industrial Effluents • Oil Spills	Contamination
• Marine Plants	• Inputs from land-based activities	Nutrient/sediment regime alterations

5.0 DISCUSSION

This report presents an analysis of the interaction of a number of ecosystem components and their perceived vulnerabilities to human activities which can contribute to environmental effects. The vulnerabilities to activities and stressors (Section 4.2) as well as the vulnerabilities to environmental effects (Section 4.3) provide key themes of potential issues that are of interest within the management mandate of Fisheries and Oceans Canada.

5.1 Important Caveats

This work was completed using the best available information which included peer-reviewed literature as well as expert opinion. Given that this report constitutes a conceptual analysis of the potential risks, it would not be appropriate to interpret these results as actual impacts. Field assessments would be required to validate the quantitative impacts of the activities and stressors on ecosystem components in order to assess the severity of impacts.

At this time, it was not deemed to be feasible to reliably consider the effect of climate change in the context of this analysis. It is recognized however, that climate change could modulate or exacerbate the effects associated to the activities and stressors identified within this report. Recent scientific information has identified key elements (e.g. Hypoxia in the Estuary and Gulf of St. Lawrence, ocean acidification impacts, change in seasonal sea-ice cover and its effects on marine mammals, etc.) having considerable impact on the ecosystems of the Estuary and Gulf of St. Lawrence (Benoît *et al.* 2012).

The basis for the identification of ecosystem component on the EBSA work is biased towards offshore areas and offshore species. For example, in interpreting the results, the reader should be reminded that the EBSA components are specific to the EBSA, which lie in water at depths greater than 30 m, while the CESS have been examined on an Estuary and Gulf-wide scale, which, depending on the species distribution, may sometimes include coastal species (i.e. eelgrass). In addition, though CESS components were analyzed on an Estuary and Gulf-wide basis, due to data availability, many of these are offshore, commercial species. Coastal ecosystem components and consequently the cumulative potential for environmental effects associated to land-based activities are largely under-represented in this analysis.

It is recognized that the availability of information regarding commercial fisheries could skew the interpretation of results if regarded entirely based on the frequency of occurrence. It is important to reiterate that most of the CESS components were selected specifically because of data availability. Species which are not regularly monitored, of commercial interest, or easily captured are expected to be relatively underrepresented in this analysis despite their potential ecological importance.

The analysis limits itself to the current context and profile of activities in the Estuary and Gulf of St. Lawrence and cannot make predictions (or analyses of trends) with respect to emerging stressors and/or activities. Thus, the absence of additional ecosystem components or risks in this report does not diminish their importance. Additional information should be considered and applied if/when it becomes available.

5.2 Ecosystem Component Profiles

The report provides a profile for 75 ecosystem components analysed in the appendices (Appendix B1-B75). Each profile is a useful reference piece on an individual basis in order to explain the rational for determining the significance of the interactions of activities and stressors on ecosystem components.

The analysis process for the ecosystem component profiles which led to the development of the hazard level criteria (Appendix A, Tables A1-A7) is seen as a significant outcome of this report and of value to future analyses. The hazard level criteria were very important to setting objective standards with which to weigh the potential likelihood and consequences of interactions between ecosystem components and activities/stressors and could be used for future analyses.

5.3 Activities and Stressors

The inclusion of activities and stressors in the analysis was based on a reasonable potential for an interaction with an ecosystem component. Greater frequency does not suggest that a greater level of impact or threshold of impact has been reached. Activities and stressors with fewer ecosystem-component/stressor interactions might have high levels of impact but on fewer ecosystem components. It was beyond the scope of this conceptual analysis to attribute the real "impacts" associated to any of the human activities. The analysis should not be considered a definitive statement on the actual risks posed to a given ecosystem component as the analysis does not reflect existing management regimes that mitigate or eliminate the potential risks which are identified in this report.

5.4 Environmental Effects

The synthesis of the activities and stressors within categories of environmental effects is meant to bring like-to-like effects together. The categories of environmental effects in relation to the

activities and stressors identified in this report all have the potential to induce significant effects on a number of ecosystem components and their functions.

The functional groups of the ecosystem components are highly relevant to the types of activities and stressors that were deemed to have the potential for environmental effects. Each species group, because of its nature, has different intrinsic susceptibilities which make it vulnerable to certain types of effects. It is therefore reasonable to assume the ecosystem components considered in this analysis could be deemed to be representative of many other species, species groups, and functions represented in the Estuary and Gulf of St. Lawrence.

For illustration purposes, eelgrass (*Zostera marina* L.) is a coastal species which is distributed throughout the region and is an important primary producer. In addition it provides a three dimensional structure that serves as an important habitat for a number of species by supporting key life history requirements such as shelter, spawning and feeding. Eelgrass is considered to play an important role in filtering the water column, stabilizing sediments and buffering shorelines. Consequently, eelgrass beds rank among the most productive ecosystems on the planet and constitute a dominant habitat feature that has an influence on the overall ecology of adjacent terrestrial and marine ecosystems. Moreover, there is no identified substitute species which could fulfill the role that eelgrass provides if it was severely perturbed. The loss of eelgrass beds would have substantial ecological consequences to the broader ecosystem. Eelgrass, as a coastal aquatic plant occurring in shallow water, has specific water quality requirements in regard to nutrients and sediments as well as physical habitat stability in order to maintain its root/leaf structure and fulfill its ecological functions. Eelgrass is therefore vulnerable to activities which induce nutrient and sediment changes or activities which cause physical alterations to its habitat or to direct destruction (including potential effects of invasive species introduction and colonization). Therefore, ensuring the survival of the eelgrass requires management actions to address all the human activities/stressors which have a potential to contribute to nutrients, sediments and habitat alterations regardless of the source of the stressors.

The implications are critical for management purposes when making decisions on an activity-by-activity basis. It is important to consider how activities and stressors can affect ecosystem components within a category of environmental effect (e.g. various activities which induce Habitat alterations) or among different categories (e.g. combined effects of Habitat alterations and Biota alterations on an ecosystem component).

5.5 Integrated Planning

The integrated management planning for the Estuary and Gulf of St. Lawrence is taking an ecosystem-based risk management approach, designed to identify and prioritize specific management issues that arise from the environmental effects of human activities. As part of the broader approach, the present analysis involved an examination of the potential co-occurrence of ecosystem components and human activities, together with analysis of how various human activities might affect ecosystem components in order to identify specific management issues.

The present report outlined the perceived vulnerabilities of several ecosystem components in order to identify the types of activities and stressors as well as the environmental effects which may be most prevalent within the region. It also provides details on a number of the potential vulnerabilities of ecosystem components across the Estuary and Gulf of St. Lawrence (Appendix B). This approach examined issues from an ecosystem-based perspective rather than a species-by-species perspective. Therefore, when managing an issue relating to environmental effects, the benefits of any intervention would be applied to a number of species

or habitat types. The key themes of potential issues that emerged from the present analysis can be summarised as:

1. Groundfish and invertebrate vulnerability to biomass removal (e.g. fishing) and physical alteration of habitats (e.g. gear impacts);
2. Pelagic fish vulnerability to biomass removal (e.g. fishing)
3. Marine mammal vulnerability to noise, entanglement, ship-strikes and contaminants (e.g. marine transportation);
4. Marine plant (i.e. eelgrass) vulnerability to biota alteration from invasive species, contaminants and nutrient input (e.g. coastal and land-based activities).

The activities listed above are managed or regulated by federal, provincial or municipal authorities to some extent. The degree to which the potential effects of an activity are mitigated depends on the existence of statutes, regulations or best management practices, the compliance level to such management actions as well as the effectiveness of their implementation and enforcement. It is important to note that while some of the activities described in this report fall under the management authority of DFO, many others fall under other authorities. This underscores the need for an integrated approach to management to effectively deal with the cumulative nature of environmental effects.

The next steps in the integrated planning process involve a validation process to determine if, when and where improvements may be required to mitigate the potential impacts from environmental effects. Some of the management measures in place may already mitigate the risks identified in this report. This understanding will come through targeted engagement with regulatory partners which have expertise and the management authority.

Integrated planning processes in the Estuary and Gulf of St. Lawrence can use this work to identify management issues from a risk-based perspective and help set priorities for policy integration among regulatory authorities.

6.0 CONCLUSIONS

The analysis undertaken in this report examined the perceived vulnerabilities of 75 key ecosystem components occurring in the Estuary and Gulf of St. Lawrence. Individual profiles where prepared for each ecosystem component in order to consider the potential significance of the interactions with human activities and stressors. Moreover, the analysis provides operational direction based on the conservation objective for the Estuary and Gulf of St. Lawrence by considering the vulnerabilities of ecosystem components, in regard to functional categories of activities and stressors as well as the potential types of environmental effects.

This report focused on issues from an ecological perspective only and, although important, it was outside of the scope of this work to consider which of the vulnerabilities identified in this report may already be effectively managed by the federal and provincial suite of regulatory tools. In complement to this vulnerability analysis, DFO is conducting a regulatory gap analysis from the key perceived vulnerabilities identified in the present report. So, it is important not to consider the identified vulnerabilities as impacts or already established management priorities. These results should rather be used as a first cornerstone which would guide future management actions by focussing on groups of vulnerable ecosystem component in order to develop effective and feasible management measures, when deemed appropriate, with regulatory authorities and partners that will benefit multiple species or habitats

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8.0 GLOSSARY

Consequence — Outcome of an event that will have an effect on objectives. There can be a range of consequences from one event. A consequence may be certain or uncertain and can have positive or negative effects on objectives. Consequences are to be understood as they relate to the organization's objectives. (ISO 2006)

Cumulative Environmental Effects — The environmental effects which are likely to result from activities in combination with the environmental effects of other past, existing and future activities. (adapted from CEAA 2006)

Changes to the environment that are caused by an action in combination with other past, present and future human actions.

DPSIR — Driver-Pressure-State-Impact-Response (DPSIR) set of definitions are regarded as the international standard categorizing information. [http://esl.jrc.it/envind/theory/handb.htm]

- Drivers: The social, cultural, economic and regulatory forces that drive human activities in the ecosystem.
- Pressures: The number or load of physical, chemical or biological products discharged or produced by the Drivers.
- State: Trends of environmental effects which reflect the current level of disruptions or alterations to habitat or biota integrity.
- Impacts: Observable impacts to ecosystem components and processes, considered as environmental degradation.
- Response: The suite of management measures implemented via regulations, policies, best management practices, standards or stewardship strategies.

Ecosystem — As defined in the Canadian Environmental Protection Act, 1999, "ecosystem" means a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit. (CEAA 2006)

Ecosystem Component — Fundamental element of the biological, physical, or chemical environment, which represents an explicit and tangible (i.e. measurable or observable) species, habitat, function or attribute.

Environment — As defined in the Act, "environment" means the components of the Earth, and includes:

(a) land, water and air, including all layers of the atmosphere,

(b) all organic and inorganic matter and living organisms, and

(c) the interacting natural systems that include components referred to in paragraphs (a) and (b) (CEAA 2006)

Environmental Effect — Environmental effects are changes in the normal processes, habitats or biota that may result in impacts to ecosystem components, goods and services.

As defined in the Canadian Environmental Assessment Act, "environmental effect" means, in respect of a project (CEAA 2006),

a. any change that the project may cause in the environment, including any change it may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of the Species at Risk Act,

b. any effect of any change referred to in paragraph (a) on 1) health and socio-economic conditions, 2) physical and cultural heritage, 3) the current use of lands and resources for traditional purposes by aboriginal persons, 4) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, or any change to the project that may be caused by

	the environment.
Extent	The point or degree of which something extends; Geographically (area, volume, distance, etc.) or Temporally (period, seasonality, punctuality).
Hazard	Used to express types of agents, processes, procedures or sites which are a potential source of harm, damage or adverse cumulative effect on which can potentially affect ecosystem components (i.e. attributes, species, habitats) based on the current best available knowledge. In this document, this refers particularly to aquatic ecosystem hazards. A biological, chemical or physical agent in, or condition, with the potential to cause an adverse health effect. (FAO-WHO 2001) The likelihood that a substance will cause an injury or adverse effect under specified conditions. (Frantzen 2002). *Often considered a synonym of "Stressor" or "Pressure": Any physical, chemical, or biological entity that can induce an adverse response. (Frantzen 2002)
Impact	There may be a range of possible impacts associated with an event. The impact of an event can be positive or negative relative to the organization's objectives. A change in a condition or state. (Frantzen 2002)
Likelihood	Refers to the chance of something happening, whether defined, measured or estimated objectively or subjectively, or in terms of general descriptors (such as rare, unlikely, likely, almost certain), frequencies or (mathematical) probabilities. (ISO 2006)
Mitigation	In respect to a source of hazards, the elimination, reduction or control of the adverse environmental effects of the activity, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means. (CEAA 2006) Any action taken to minimize, at the optimal costs, losses which strike the organization, and limitation of any negative consequence of a particular event. (ISO 2006)
Profile	A formal summary or analysis of data, often in the form of a graph or table, representing distinctive features or characteristics. An analysis representing the extent to which something exhibits various characteristics; standardization, a profile consists of an agreed-upon subset and interpretation of a specification formal summary or analysis of data, often in the form of a graph or table, representing distinctive features or characteristics.
Reversibility	Refers to the potential to return to the previous ecological state, from an altered state, once an environmental pressure is reduced or removed.
Risk	Defined in the document "Integrated risk management framework" (TBS 2001) by the Privy Council Office of Canada and the Treasury Board as "the expression of the likelihood and impact of an event with potential to influence the achievement of an organizations objective" in the background to the definition the authors are careful to note that "Although this definition of risk refers to the negative impact of the issue, the report acknowledges that there are also positive opportunities arising from the responsible risk-taking and that innovation and risk co-exist frequently". A function of the probability of an adverse health effect and the severity of that effect, consequential to a hazard(s). (FAO-WHO 2001) The probability of a substance (chemical, physical or biological) will produce harm under specific conditions. (Frantzen 2002)
Risk Analysis	The systematic use of information to identify hazards and estimate the chance for, and severity of consequences. (CSA 1997)

	A process consisting of four components: ecosystem vulnerability profile, risk assessment, risk management and risk communication. (modified from FAO-WHO 2001)
	Process of systematic use of information to estimate/understand the risk. (ISO 2006)
Risk Management	The process, distinct from risk assessment, of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other factors relevant for the health protection of consumers and for the promotion of fair trade practices, and, if needed, selecting appropriate prevention and control options. (FAO-WHO 2001):
	The broad decision-making structure within which environmental risk assessment contributes. It includes assessments of ecological, social and economic risks and has the objective of reducing risk to its most cost-effective level.
Severity	The degree of an undesirable outcome or effect.
Stressor	Any physical, chemical, or biological entity that can induce an adverse response. (Frantzen 2002) *Considered a synonym of "Pressure" in this document.
Susceptibility	Susceptibility is the extent to which an organism or ecological community would suffer from a hazard, threatening process or factor if exposed, without regard to the likelihood of exposure.
Uncertainty	State, even partial, of deficiency of information related to a future situation. (ISO 2006)
	A lack of confidence in the prediction of a risk assessment that may result from natural variability in natural processes, imperfect or incomplete knowledge, or errors in conducting an assessment.
Vulnerability	Refers to an inherent susceptibility of an ecosystem component in relation to the potential effects of a hazard which can cause adverse consequences.
	Vulnerability takes into account both the effect of exposure and the likelihood of exposure.

APPENDIX A - RELATIVE RISK METHODOLOGY

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RELATIVE RISK METHODOLOGY

The relative risk posed by the selected activities/stressors for a CESS component was assessed using a ranking process (see figure 2). Each activity/stressor deemed to potentially affect a given species was given a rank according to its Magnitude of interaction and Sensitivity risk parameters. For each of the CESS risk parameters (e.g. areal extent), five hazard levels were allocated using a classification adapted from the principles of the DFO Integrated Risk Management Policy (DFO 2004b, Fletcher *et al.* 2010) and criteria (Gilles Olivier pers. comm., 2009). The hazard levels were based on a risk analysis approach for considering the potential likelihood of an interaction between an activity/stressor and a component as well as the potential consequences (e.g., extreme, negligible) if an interaction occurs (Tables A1 to A7).

The rationale for the assignment of a particular hazard level to each risk parameter for a given activity on a species was based on peer-reviewed literature and expert opinion.

Although the analysis is qualitative, hazard levels were assigned a numerical value (1 to 5) for the purposes of representing them graphically in the profiles. This process was summarized in 23 Excel spreadsheets providing transparency.

The Magnitude of Interaction and Sensitivity of a species to an activity/stressor was derived by combining hazard levels ranks (1-5) for each risk parameter (e.g. resilience; areal extent, etc., see Table 4). The composite ranking for MOI and S risk parameters of a given activity/stressor were then plotted on a coloured graph (Relative Risk Graph) for each CESS in order to illustrate their relative likelihood and severity. Accordingly, each point in the graph represents an important interaction between a given CESS ecosystem component and a selected key activity/stressor. The exact position of a point (interaction) is less important than the relative positions of the points in the graphs. All the points illustrate important or greater risks potential interactions but one located at the right upper corner of the graph could pose a higher relative risk for an ecosystem component.

Relative risk graphs can be useful for Oceans Managers: They could help to prioritize among the future potential priorities. The results of the relative risk ranking are presented in appendix B53-B75 CESS profiles.

Table A1: Hazard Level Criteria for Magnitude of Interaction for CESS– Areal Extent.

Areal Extent	
Hazard Level	Criteria
Almost Certain	The activity/stressor is **almost certain** to coincide geospatially with a significant proportion of the species distribution in the ecological unit (distribution overlap > 95%).
Likely	The activity/stressor is **likely** to coincide geospatially with a significant proportion of the species distribution in the ecological unit (distribution overlap 75-95%).
Moderate	The activity/stressor has a **moderate** likelihood of coinciding geospatially with a significant proportion of the species distribution in the ecological unit (distribution overlap 25-75%).
Unlikely	The activity/stressor is **unlikely** to coincide geospatially with a significant proportion of the species distribution in the ecological unit (distribution overlap 5-25%).
Rare	The activity/stressor would **rarely** coincides geospatially with a significant proportion of the species distribution in the ecological unit (distribution overlap < 5%).

Table A2: Hazard Level Criteria for Magnitude of Interaction for CESS – Contact.

Contact	
Hazard Level	Criteria
Almost Certain	There is an expectation that when the activity/stressor coincides with the species in question, it is **almost certain** to have a direct physical interaction with the species or direct effects to the species (estimated likelihood of contact > 95%). This may include active or incidental targeting of the areas occupied by the species (e.g., directed fishing) with gear or mechanisms (e.g., mesh size) or other effects (e.g., pollution, noise, strikes).
Likely	There is an expectation that when the activity/stressor coincides with the species in question, it is **likely** to have a direct physical interaction with the species or direct effects to the species (estimated likelihood of contact 75-95%).
Moderate	There is an expectation that when the activity/stressor coincides with the species in question, it will have a **moderate** likelihood of having a direct physical interaction with the species or direct effects to the species (estimated likelihood of contact 25-75%).
Unlikely	There is an expectation that when the activity/stressor coincides with the species in question, it is **unlikely** to have a direct physical interaction with the species or direct effects to the species (estimated likelihood of contact 5-25%).
Rare	There is an expectation that when the activity/stressor coincides with the species in question it would be **rare** to have a direct physical interaction with the species or direct effects to the species (estimated likelihood of contact < 5%).

Table A3: Hazard Level Criteria for Magnitude of Interaction for CESS – Duration.

Duration	
Hazard Level	Criteria
Almost Certain	The temporal period where the activity/stressor is active* is **almost certain** to coincide significantly with the species in the ecological unit (temporal overlap > 95%).
Likely	The temporal period where the activity/stressor is active is **likely** to coincide significantly with the species in the ecological unit (temporal overlap 75-95%).
Moderate	The temporal period where the activity/stressor is active has a **moderate** likelihood of coinciding significantly with the species in the ecological unit (temporal overlap 25-75%).
Unlikely	The temporal period where the activity/stressor is active is **unlikely** to coincide significantly with the species in the ecological unit (temporal 5-25%).
Rare	The temporal period where the activity/stressor is active would **rarely** coincide significantly with the species in the ecological unit (temporal overlap < 5%).

*An "active" activity/stressor means that the activity is ongoing (e.g., seasonal fishing period, active discharges or waste, physical emplacement of structure associated to the activity) or that the stressors associated to the activity continue to actively disrupt the species after the activity has stopped (e.g., chronic leaking of oil).

Table A4: Hazard Level Criteria for Magnitude of Interaction for CESS – Intensity.

Intensity*	
Hazard Level	Criteria
Almost Certain	The frequency of the activity/stressor is such that there is an expectation that when it coincides with the species and/or its habitat it will **almost certainly** do so repeatedly (estimated frequency of repeated interactions > 95% of the time).
Likely	The frequency of the activity/stressor is such that there is an expectation that when it coincides with the species and/or its habitat it is **likely** do so repeatedly (estimated frequency of repeated interactions 75-95% of the time).
Moderate	The frequency of the activity/stressor is such that there is an expectation that when it coincides with the species and/or its habitat it has a **moderate** likelihood of doing so repeatedly (estimated frequency of repeated interactions 25-75% of the time).
Unlikely	The frequency of the activity/stressor is such that there is an expectation that when it coincides with the species and/or its habitat it is **unlikely** do so repeatedly (estimated frequency of repeated interactions 5-25% of the time).
Rare	The frequency of the activity/stressor is such that there is an expectation that when it coincides with the species and/or its habitat it will **rarely** do so repeatedly (estimated frequency of repeated interactions < 5% of the time).

*Intensity represents of the relative level of effort, volume, and frequency of interactions between the activity/stressor and the species and/or its habitat. This is based on an expectation of the frequency of interactions. Examples: 1. Frequency of boats (number) and activity level (fishing days) within the areas frequented by the species; 2. Frequency of boat traffic (average number/day) in the area frequented by the species.

Table A5: Hazard Level Criteria for Sensitivity for CESS – Acute and Chronic Impacts

Acute and Chronic Impacts (severity)	
Hazard Level	Criteria
Extreme	The severity of the impact associated with the activity/stressor on the species/habitat is considered to be **extreme**. The severity of the acute and chronic impacts to the habitat includes effects to the habitat's ability to support the species in question as well as other species that use that habitat. For example, effects may be reversible over extended term (> 30 years) with active management or effects may be irreversible. This can represents a permanent, large scale loss of fish habitat.
Very High	The severity of the impact associated with the activity/stressor on the species/habitat is considered to be **very high**. For example, effects may be reversible over extended term (10-30 years) with active management. This can represent a severely fragmented habitat or habitat known to exist at only a few locations.
Medium	The severity of the impact associated with the activity/stressor on the species/habitat is considered to be **medium**. This can represent a moderate impact to fish habitat, with longer term (3-10 years) for recovery.
Low	The severity of the impact associated to the activity/stressor on the species/habitat is considered to be **low**. This can represent a minor impact to fish habitat with short term recovery (less than 3 years).
Negligible	The severity of the impact associated with the activity/stressor on the species/habitat is considered to be **negligible**. This can represent a habitat change within the range of natural variability (i.e. regular storm events or seasonal perturbations such as ice scouring).

Table A6: Hazard Level Criteria for Sensitivity for CESS – Ecological Importance.

Ecological Importance	
Hazard Level	Criteria
Extreme	The loss or significant decline of the species in question would represent an **extreme** disruption to the overall ecosystem function*. For example, the permanent loss of an ecological function which cannot be replaced by any other species (e.g., unique functions provided by eelgrass in an estuary, that other species cannot replace) and therefore results in a trophic cascade of impacts.
Very High	The loss or significant decline of the species in question would represent a **very high** disruption to the ecosystem function. For example, the disruptions of an ecological function which can only be partially replaced by other species and where there is some degree of permanent loss (e.g., partial control of nutrients by oyster filtration to compensate for loss of eelgrass nutrient absorption) and therefore results in trophic impacts.
Medium	The loss or significant decline of the species in question would represent a **medium** disruption to the ecosystem function. For example, the disruptions of an ecological function which can be replaced by other species but for which the replacement is less effective (e.g. lower rate of filtration by oyster when compared to mussels).
Low	The loss or significant decline of the species in question would represent a **low** disruption to the ecosystem function. For example, the disruptions of an ecological function which can be effectively replaced by a species with a similar ecological niche after a short period of readjustments of the species dynamics (e.g., change in dominance between two similar species).
Negligible	The loss or significant decline of the species in question would represent a **negligible** disruption to the overall ecosystem function.

*Based the CSAS guidance (2006c) for ESS on one or more of the following functions attributed to the species 1) its role as a "key" trophic species, 2) its role as a forage species, 3) its role as a highly influential predator, 4) it's role in nutrient cycling, 5) its role providing structure.

Table A7: Hazard Level Criteria for Sensitivity for CESS – Resilience.

Resilience	
Hazard Level	Criteria
Extreme	The species has a sensitivity that would be considered as **extreme** in regard to its resilience to changes and perturbations (i.e. very poor resiliency).*For example, a species that is particularly susceptible to impacts and may not be able to recover without active management measures as species reintroduction, captive breeding programs, extreme protection measures (e.g., leatherback turtle - egg protection, captive breeding, etc.).
Very High	The species has a sensitivity that would be considered as **very high** in regard to its resilience to changes and perturbations (i.e. poor resiliency). For example, a species that is particularly susceptible to impacts and would require a significant period to recover naturally from any losses as species at low population levels, with long periods for breeding (e.g., species such as belugas, cod, etc.).
Medium	The species has a sensitivity that would be considered as **medium** in regard to its resilience to changes and perturbations (i.e. moderate resiliency). For example, a species that is robust to many impacts but which would still require a significant period to recover naturally from any losses as species which are not particularly fragile, but which have an extended age at sexual maturity, localized populations, particularly long incubation of eggs, etc.
Low	The species has a sensitivity that would be considered as **low** in regard to its resilience to changes and perturbations (i.e. fair resiliency). For example, a species that is robust to many impacts and which could recover naturally from even moderate losses over a few reproductive generations as robust species which can be exploited heavily but still maintain a reproductive capacity and could easily bounce back if the pressures where removed (e.g., lobster and snow crab).
Negligible	The species has a sensitivity that would be considered as **negligible** in regard to its resilience to changes and perturbations (i.e. high resiliency). For example, a species that is robust to many impacts and which could recover naturally from even severe losses over a few reproductive generations (e.g., species at high population levels, widespread populations (e.g., barnacles), some pelagic species, and species that might be difficult to exterminate even if we wanted to (e.g. green crab).

*Resilience means the ability to resists damage and recovers quickly from stochastic disturbances. Factors which can be considered include 1) the degree of specialization in food or habitat requirements, 2) the longevity and or age at sexual maturity and number of offspring, 3) particularly vulnerable stages of their life-cycle with low survival rates, 4) intrinsic behaviour which makes the species more likely to be affected by stressor impacts.

APPENDIX B - ECOSYTEM COMPONENT PROFILES

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EBSA Components

Appendix B1: Features of Western Cape Breton: Meroplankton species (witch flounder, Atlantic cod, winter flounder, American plaice, yellowtail flounder, and decapod crustaceans)

EBSA 1 – Western Cape Breton (8,198 km²; 3.2 % of the EGSL)

Scoping:

Seven (7) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Noise & disturbance	Oil spills & pollution	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Vessel Traffic	--	N	--	--	--	--	--
Seismic surveys	N	--	--	--	--	--	--
Human activity-induced climate change	--	--	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Vessel traffic stands out as the most likely source to produce a spill of sufficient magnitude in this area to cause significant harm to the marine environment. Meroplankton is not generally considered to be at high risk because most of the effects of oil pollution tend to be felt on the surface of the ocean or in the tidal zone on shore.

There is no evidence to support the concern that noise and pressure changes associated with conventional seismic surveys impact these meroplankton species. There is, however, a concern that effects from seismic surveys may be observed in decapod crustacean eggs and larvae. However, surveys of this kind are not frequent and they tend to focus on the narrow area surrounding a potential area of interest for oil and gas development, therefore decapod crustacean meroplankton would not be affected.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B2: Features of Western Cape Breton: Meroplankton abundance (eggs and larvae)

EBSA 1 – Western Cape Breton (8,198 km²; 3.2 % of the EGSL)

Scoping:
Seven (7) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Noise & disturbance	Oil spills & pollution	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Vessel Traffic	–	N	–	–	–	–	–
Seismic surveys	N	–	–	–	–	–	–
Human activity-induced climate change	–	–	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Vessel traffic has the potential to cause large scale oil spills. Meroplankton is not generally considered to be at high risk because most of the effects of oil pollution occur on the surface of the ocean or in the intertidal zone.

There is no evidence to support the concern that noise and pressure changes associated with conventional seismic surveys impact these meroplankton species. There is, however, a concern that effects from seismic surveys may be observed in decapod crustacean eggs and larvae. However, surveys of this kind are not frequent and they tend to focus on the narrow area surrounding a potential area of interest for oil and gas development, therefore, decapod crustacean meroplankton would not be affected.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B3: Features of Western Cape Breton: Primary productivity for mesozooplankton (< 1mm)

EBSA 1 – Western Cape Breton (8,198 km²; 3.2 % of the EGSL)

Scoping:
Six (6) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Toxic algal blooms	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Ballast water exchange	N	--	--	--	--	--
Human activity-induced climate change	--	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Most algal blooms happen spontaneously without any known link to human activity. However, in some instances, human activity has been identified as a contributing factor (i.e., by causing an increase in nutrients or water temperature, or as a result of the release of the causative agents in ballast water). There are no incidents cited in the literature where a toxic algal bloom, directly attributable to human causes, was shown to be responsible for a significant impact on the mesozooplankton population this area.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B4: Features of Western Cape Breton: Spring/fall migration for southern Gulf cod and coastal component of southern Gulf white hake

EBSA 1 – Western Cape Breton (8,198 km²; 3.2% of the EGSL)

Scoping:
Ten (10) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Ghost nets	Ice distribution	Temperature & salinity change	Change in ocean currents
Bottom trawl	Y	--	--	--	--
Gillnet (bottom)	N	N	--	--	--
Gillnet (pelagic)	--	N	--	--	--
Longline	Y	--	--	--	--
Scottish/Danish Seine	Y	--	--	--	--
Handline	Y	--	--	--	--
Human activity-induced climate change	--	--	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Gillnets (bottom) have not been a significant factor for biomass removal for cod historically and in the last 10 years have not represented a threat for white hake. Ghost nets represent a considerable reduced level of threat for two reasons. First of all, in any given area they are not as numerous as deliberately set fishing gear and secondly, as time passes they become less and less efficient at fishing since they become fouled and floats either are degraded or otherwise lose their ability to suspend the net off bottom. Ghost nets are not considered to be a serious enough threat to warrant further consideration.

Ghost nets from the pelagic gillnet fishery are considered to be even less of a threat to Atlantic cod or white hake than bottom gills nets and warrant no further consideration.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Bottom trawls contribute to a measurable amount of biomass removal for both species.

Longlines have not played a significant role in biomass removal historically for either Atlantic cod or white hake in the southern Gulf, however over the last 10 years white hake landings by longline have contributed to 34.5% of the catch.

Landings of white hake by-catch by Scottish/Danish seines have fallen significantly over the last several years, though they still represent 39.6% of the catch and are used during late spring and early summer.

Landings by handlines contribute very little to the white hake fishery; however this gear represents 67.5% of landings of cod in this area.

Appendix B5: Features of Western Cape Breton: Summer feeding grounds for adult witch flounder and white hake

EBSA 1 – Western Cape Breton (8,198 km²; 3.2 % of the EGSL)

Scoping:
Seven (7) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents
Bottom Trawls	Y	–	–	–	–
Longlines	Y	–	–	–	–
Danish Seine	Y	–	–	–	–
Human induced climate change	–	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Although a fishing moratorium led to the closure of the directed fishery for white hake in the southern Gulf of St. Lawrence in 1995, limited removals still occur as part of the sentinel survey and as by-catch in other groundfish fisheries. Witch flounder are also caught in the sentinel survey and mainly as a by-catch of the bottom trawl fishery.

Longlines have not played a significant role in biomass removal historically for white hake in the southern Gulf; however over the last 10 years white hake landings by longlines have contributed to 34.5% of the catch.

Danish seines are used in the small directed witch flounder fishery off western Cape Breton Island.

Appendix B6: Features of Western Cape Breton: Benthic invertebrates (brittle star, starfish, basket star, hermit crab)

EBSA 1 – Western Cape Breton (8,198 km²; 3.2% of the EGSL)

Scoping:
Eight (8) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents
Bottom trawl	N	N	–	–	–	–
Scallop dredge	N	N	–	–	–	–
Human activity-induced climate change	–	–	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – A great deal of concern and attention has been attached to the issue of benthic habitat damage due to trawling over the past decade. Many studies are available that attempt to quantify the harm done by bottom trawling in various ecosystems and habitat types. It is recognized that bottom trawls have a very real potential to do a great deal of harm to both benthic organisms and their habitat. However, considering the vastness of the populations of these organisms and the severely reduced level of effort utilizing this gear type in the area in the recent past, it must be concluded that this is not a significant threat to these benthic species in EBSA 1.

Compared to the level of effort represented by the use of bottom trawls in this area, scallop drags are only a minor human activity. They are used by fewer fishermen, over a smaller area and over a shorter season than bottom trawls. Even though they undoubtedly impact to a greater extent on littoral species like hermit crabs than do bottom trawls, which are largely confined to deeper water, the overall effect on all four species is low across the area.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B7: Features of Western Cape Breton: Marine mammals (grey seals, hooded seals, harp seals (winter), striped dolphin, white whale, pilot whale (summer))

EBSA 1 – Western Cape Breton (8,198 km²; 3.2 % of the EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Noise & disturbance	Ship strikes & collisions	Entanglement	Ice distribution	Temperature/ &salinity change	Change in ocean currents
Gill nets (pelagic)	--	--	--	Y	--	--	--
Seal hunt	N	--	--	--	--	--	--
Ecotourism	--	N	--	--	--	--	--
Vessel traffic	--	Y	Y	--	--	--	--
Seismic surveys	--	N	--	--	--	--	--
Human induced climate change	--	--	--	--	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Biomass removal of harp seals in the commercial hunt in this area is well within the limit of sustainability (only half the Gulf quota of 51,500 seals taken in 2008). Research shows that the population of harp seals is increasing and therefore biomass removal from this activity is not a concern.

Noise caused by ecotourism can potentially disrupt marine mammals however there are laws forbidding harassment and defining acceptable proximity to marine mammals.

Noise from seismic surveys could disrupt normal marine mammal movements however this is not an area of intense seismic survey activity.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Entanglement in pelagic gillnets have been found to pose a particular threat to whales and seals. There is potential for entanglement because of the use of gillnets in this EBSA.

Both noise and ship strikes from vessel traffic are a concern for marine mammals in this area.

Appendix B8: Features of St Georges Bay: Meroplankton abundance and diversity

EBSA 2 – St. Georges Bay (1,216 km²; 0.5% of the EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analyzed.

Activities/stressors	Sewage	Nutrient input	Oxygen depletion	Change in freshwater input	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Human settlement	N	Y	N	–	–	–	–	–	–
Human activity-induced climate change	–	–	–	N	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Concerns with human settlement include a number of related stressors: sewage, oxygen depletion and nutrient input. These can result from the communities themselves, in the case of sewage for example, but can also come from non-point dispersed sources such as agriculture, forestry and other activities related to habitation along the coast. There is concern in this bay, as there is in bays throughout the southern Gulf concerning an apparent increase in eutrophication with attendant impacts on biological communities at the secondary production level. The problem is already pronounced with a relatively small human population base and stands to worsen as the population grows.

Appendix B9: Features of St Georges Bay: Pelagic feeding (alewife, spiny dogfish, Atlantic herring, Atlantic mackerel)

EBSA 2 – St. Georges Bay (1 216 km²; 0.5 % of the EGSL)

Scoping:
Thirteen (13) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Ghost nets	Change in freshwater input	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Bottom Trawl	N	--	--	--	--	--	--	--
Gill nets (pelagic)	Y	N	--	--	--	--	--	--
Longline	N	--	--	--	--	--	--	--
Handline	N	--	--	--	--	--	--	--
Mackerel traps	N	--	--	--	--	--	--	--
Jigging Machine	Y	--	--	--	--	--	--	--
Human induced climate change	--	--	N	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Bottom trawls can capture pelagic species especially when used in shallower waters and but because they are either never used or only infrequently used in the Bay, it is not considered a threat to summer feeding of pelagic fish in this area.

Lost pelagic gillnets (ghost nets) are not considered because they sink to the bottom and are unlikely to constitute a significant threat to pelagic species in general.

Longlines and handlines can potentially capture spiny dogfish, but there is no directed fisheries aimed at catching spiny dogfish with these gears.

Mackerel traps are not a common gear in this area and therefore they do not pose a significant threat to pelagic species in this bay.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Pelagic gillnets constitute an effective means of capture for most pelagic species.

There has been an increase in jigging for mackerel and this activity does contribute to biomass removal of mackerel in St. Georges Bay.

Appendix B10: Features of St Georges Bay: Spawning, rearing, and summer feeding for coastal component of white hake Gulf stock

EBSA 2 – St. Georges Bay (1,216 km²; 0.5% of the EGSL)

Scoping:
Fourteen (14) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Sewage	Nutrient input	Oxygen depletion	Ocean acidification	Ice distribution	Temperature & salinity change	Sea-level rise	Increased storms & surges	Invasive species
Bottom Trawl	N	–	–	–	–	–	–	–	–	–
Gillnet (bottom)	N	–	–	–	–	–	–	–	–	–
Longline	Y	–	–	–	–	–	–	–	–	–
Scottish/Danish Seine	N	–	–	–	–	–	–	–	–	–
Handline	N	–	–	–	–	–	–	–	–	–
Human settlement	–	N	Y	N	–	–	–	–	–	–
Human activity-induced climate change	–	–	–	–	N	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – The evidence concerning fishing methods responsible for the landings of white hake in the southern Gulf indicates that bottom trawl, gillnet (bottom), Scottish-Danish seine and handline do not pose a significant threat.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – The majority of white hake are taken from July to October as incidental by-catch by longlines. Therefore this fishing practice is considered an important stressor in this area.

Concerns with human settlement include a number of related stressors: sewage, oxygen depletion and nutrient input. These can result from the communities themselves, in the case of sewage for example, but can also come from non-point dispersed sources such as agriculture, forestry and other activities related to habitation along the coast. There is concern in this bay, as there is in bays throughout the southern Gulf, concerning an apparent increase in eutrophication with attendant impacts on biological communities at the secondary production level, thus affecting spawning and feeding of juvenile white hake. The problem is already pronounced with a relatively small human population base and stands to worsen as the population grows.

Appendix B11: Features of St Georges Bay: Nursing grey seals

EBSA 2 – St. Georges Bay (1,216 km²; 0.5 % of the EGSL)

Scoping:
Eight (8) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Noise/Disturbance	Ice distribution	Temperature & salinity change	Sea level rise	Change in ocean currents	Increased storms & surges
Seal Hunt	N	--	--	--	--	--	--
Vessel traffic	--	N	N	--	--	--	--
Human induced climate change	--	--	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The total allowable catch for the entire Atlantic seal hunt in 2008 was set at 275,000 harp seals, which included 2,000 seals for personal seal hunting, 4,950 seals for the Aboriginal seal hunt, and 16,186 seals carried over for those who did not capture their quota in 2007. The Gulf of St. Lawrence fleets received a 30% share of this quota after the carry-over was deducted. The Atlantic seal hunt also included quotas of 8,200 hooded seals (this hunt is closed in the Gulf) and 12,000 grey seals. The biomass removal of grey seals is small and well within the limits of sustainability. For this reason, the seal hunt is not considered a threat to this species.

The effects of noise and disturbance on nursing grey seals by vessel traffic are a concern as is the effect of vessel traffic on ice distribution. The stability of the ice is important for females to successfully rear their young, since suckling occurs only on the ice. It is also important for pups because without access to stable ice to rest, the pups quickly tire and often drown. Grey seals use this area for nursing from the end of December to January. Because the ice begins to form in December each year, fishing vessels are not active in this area and the Canso Canal, a secondary traffic route for commercial vessels, closes annually on December 23rd. Therefore, vessel traffic ceases before whelping begins.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B12: Features of Western Northumberland Strait: Lady Crab

EBSA 3 – Western Northumberland Strait (9,046 km²; 3.5% of the EGSL)

Scoping:
Twelve (12) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ocean acidification	Ice distribution	Temperature & salinity change	Sea-level rise	Increased storms & surges	Increased UV radiation	Invasive species
Bottom trawl	N	N	–	–	–	–	–	–	–
Scallop dredge	N	Y	–	–	–	–	–	–	–
Pots	Y	–	–	–	–	–	–	–	–
Human activity-induced climate change	–	–	N	N	N	N	N	N	N

Y = Activity/stressor screened in
N = Activity/stressor screened out
-- = Irrelevant

Excluded – Bottom trawls are not frequently used in the Northumberland Strait and therefore do not pose a significant threat to lady crabs.

Scallop drags are still in common use in the Northumberland Strait, however scallop dragging takes place over an extremely limited portion of the Strait and therefore the risk of biomass removal is not significant.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Rock crab has been a directed fishery of some magnitude since the early 1980s with landings increasing from 354 tonnes to 1,560 tonnes between 1991 and 2003. There is also an intensive lobster fishery in the western Northumberland Strait. Although there are no records available of the number of lady crab taken as by-catch in the rock crab or lobster fisheries, it must be considered as a risk factor, particularly considering that rock crab and lady crab are essentially co-located.

As previously stated, scallop dragging takes place over limited portion of the Northumberland Strait; however it is believed that the risk of habitat alteration is significant.

Appendix B13: Features of Western Northumberland Strait: Winter skate concentration in summer/fall

EBSA 3 – Western Northumberland Strait (2,194 km²; 0.9 % of the EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ocean acidification	Temperature & salinity change	Change in ocean currents
Bottom Trawl	N	N	–	--	–
Scallop drags	N	N	–	–	–
Gillnet (bottom)	N	–	–	--	–
Scottish/Danish seine	N	–	–	–	–
Human activity-induced climate change	–	–	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Bottom trawls are used in deeper waters outside the shallow depth range of winter skate concentrations. Trawling may physically alter bottom habitat and re-suspension bottom sediments that might smother spawning areas and damage gills. However, there is a low probability that alteration of the bottom by trawling would affect adults, given their preference for sand and gravel bottoms.

Studies on the by-catch of winter skates in the scallop fishery indicate that few individuals are captured and survival following discarding appears to be high (pers. comm., Hugues Benoît, Fisheries and Oceans Canada). As of 2005, a coastal buffer zone has been in place in Lobster Fishing Area 22 to exclude scallop dragging in waters less than 10 fathoms (~20 m), thus protecting the majority of winter skate, which concentrate in depths of less than 18 m in this area (pers. comm., Hugues Benoît, Fisheries and Oceans Canada). Therefore, by-catch and habitat alteration caused by this activity is not considered a significant threat to the winter skate population.

The concern with gillnet (bottom) is winter skate by-catch but as with other gears, by-catch has been greatly reduced in all gears and this is not a significant concern.

There is a potential for by-catch in the Scottish and Danish seines fisheries, however this gear is not used in this area.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B14: Features of Western Northumberland Strait: Groundfish (white hake, window pane)

EBSA 3 – Western Northumberland Strait (9,046 km²; 3.5% of the EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ocean acidification	Temperature & salinity change	Change in ocean currents
Bottom Trawl	N	–	–	–	–
Gillnet (bottom)	N	–	–	–	–
Scallop dredge	N	N	–	–	–
Scottish/Danish seine	N	–	–	–	–
Handline	N	–	–	–	–
Human activity-induced climate change	–	–	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Fisheries for groundfish such as the cod, witch flounder and American plaice no longer occur in the western portion of the Northumberland Strait, therefore reducing or eliminating the use of bottom trawl and Danish/Scottish seine gear in this area.

Bottom gillnets and handlines are the only gears of significance that have captured white hake as a by-catch in the western Northumberland Strait over the last 10 years, however over the last 7 years, by-catch has been minimal to none.

It seems only logical to assume that slow moving bottom species, such as the windowpane, would be vulnerable to scallop drags as is found with winter skate, though there is no evidence to this effect. White hake, being less closely associated with the bottom and generally a faster, more mobile species would not be as seriously affected. In terms of habitat alteration, this is likely to be a short-term effect and is more likely to affect the prey of these species, which again is a short-term effect.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B15: Features of southern fringe of the Laurentian Channel: Overwintering of southern Gulf Atlantic cod

EBSA 4 – Southern fringe of the Laurentian Channel (5,941km²; 2.3 % of the EGSL)

Scoping:
Ten (10) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass Removal	Habitat alteration	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents
Bottom trawl	N	N	–	–	–	–
Gillnets (bottom)	N	–	–	–	–	–
Longline	N	N	–	–	–	–
Scottish/Danish seine	N	–	–	–	–	–
Human activity-induced climate change	–	–	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Biomass removal by bottom trawls is not considered a significant risk factor because trawling intensity is low during the overwintering period of the southern Gulf Atlantic cod. Habitat alteration, while there is little doubt of the negative effects of this human activity on the supporting habitat of Atlantic cod among many other species, there is little bottom trawling taking place in the specific area of EBSA 4 during the overwintering period.

Approximately 8.5% of Atlantic cod landings in the southern Gulf are taken in gillnets. Though not inconsiderable, this is a relatively small component of the overall take and none of this fishing effort takes place in this area during the overwintering period.

Over 17% of the cod landed in the southern Gulf are taken by longline. However, the fishing effort lies outside this area, thus eliminating any significant impacts to this species in terms of both biomass removal and habitat alteration.

About 25% of the cod taken in the southern Gulf is captured in seines. This represents a significant increase in the proportion of the catch taken by this gear relative to the historic catch, probably because of efforts to reduce the impacts caused by the use of bottom trawls. However, this gear is not extensively used in EBSA 4 and is never used in winter; therefore this human activity is not considered a significant concern to this species.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B16: Features of southern fringe of the Laurentian Channel: Feeding, migration, and shelter for pelagic fish (Atlantic herring, capelin, white barracudina, spiny dogfish)

EBSA 4 – Southern fringe of the Laurentian Channel (5,941 km²; 2.3% of the EGSL)

Scoping:
Five (5) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ocean acidification
Bottom trawl	Y	N	--
Midwater trawl	N	--	--
Scottish/Danish seine	N	--	--
Human Activity-Induced Climate Change	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Habitat alteration caused by bottom trawls is excluded because some of these species are exclusively pelagic feeders, relying more on plankton and ichthyoplankton than benthic organisms. In addition, none of these species exhibit obvious signs of stress attributed directly to this stressor. This may be in part due to their migratory patterns, which allow them to move to less disturbed areas to feed and find refuge.

Mid-water trawls are not used in this area.

Only a minor portion of EBSA 4 is subject to seining. By-catch is expected to be negligible.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Bottom trawls capture pelagic species, especially bathy-pelagic species such as barracudina and spiny dogfish.

Appendix B17: Features of southern fringe of the Laurentian Channel: Feeding, migration, and shelter for groundfish (pollock, silver hake)

EBSA 4 – Southern Fringe of the Laurentian Channel (5,941 km²; 2.3% of the EGSL)

Scoping:
Eight (8) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents
Bottom trawl	Y	N	–	–	–	–
Mid-water trawl	N	–	–	–	–	–
Scottish/Danish seine	N	–	–	–	–	–
Human Activity-Induced Climate Change	–	–	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Bottom trawls are known to be among the most destructive forms of fishing gear still in use globally. They scour and damage bottom habitats resulting in loss of resources and diminished productivity. However, none of these species exhibits obvious signs of stress attributed directly to this stressor. Habitat alteration may not significantly affect these species since they are largely if not exclusively pelagic feeders. As well-being migratory in nature they are able to move to other areas for feeding and shelter. For these reasons, habitat alteration is not considered for further analysis.

Mid-water trawl is not used in this area.

Although Scottish and Danish seines are designed to target groundfish, only a minor portion of EBSA 4 is subject to seining. By-catch is also expected to be minimal and therefore this activity is screened out.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – The fringe of the Laurentian Channel is subject to higher than normal bottom trawling pressure and thus biomass removal in the form of by-catch may be a concern for these species.

Appendix B18: Features of southern fringe of the Laurentian Channel: Spring/fall migration of groundfish (southern Gulf Atlantic cod, white hake, etc.)

EBSA 4 – Southern fringe of the Laurentian Channel (5,941 km²; 2.3% of the EGSL)

Scoping:
Thirteen (13) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Oil spills & pollution	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Invasive species
Bottom trawl	Y	N	–	–	–	–	–	–
Midwater trawl	N	–	–	–	–	–	–	–
Gillnet (bottom)	N	–	–	–	–	–	–	–
Longline	N	–	–	–	–	–	–	–
Scottish/Danish seine	Y	–	–	–	–	–	–	–
Vessel traffic	–	–	N	–	–	–	–	–
Ballast water exchange	–	–	N	–	–	–	–	N
Human activity-induced climate change	–	–	–	N	N	N	N	–

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Habitat alteration caused by bottom trawl is not likely to have a significant effect on these species during spring and fall migrations and is not considered further in the analysis. Midwater trawl is not commonly used in this area and therefore is not a risk to these species. Bottom gillnets are best suited and most commonly used in shallower water, therefore this activity is not a significant threat. Longline does not comprise a significant method for directed cod fisheries in this location.

Regulatory control measures in the Vessel Traffic Service corridor are strict and well enforced by Transport Canada, the Canadian Coast Guard and Environment Canada. Despite these tight regulatory controls, there is ample evidence that inadvertent and sometimes deliberate evacuation of bilge results in chronic low level oil pollution along traffic routes such as this one. The significance of marine pollution and oil spills to migration of groundfish is judged to be low and not considered further.

Given the Ballast Water Control and Management Regulations introduced by Transport Canada and that risks associated with the introduction of invasive species are primarily associated with coastal benthic species and species raised in aquaculture, there has yet to be demonstrated any immediate effect on groundfish and this is not considered further for analysis.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – The fringe of the Laurentian Channel is subject to higher than normal trawling pressure that falls within the timing of the migratory movements of these species. Only a small portion of EBSA 4 is subject to a greater than average amount of seining. However, these locations coincide with the locations of highest density of cod and hake during their migrations.

Appendix B19: Features of southwestern coast of the Gulf: Zooplankton production and accumulation

EBSA: 5 – South-western Coast of the Gulf (13,506 km²; 5.3% of the EGSL)

Scoping:
Five (5) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Change in freshwater input	Toxic algal blooms	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Human activity-induced climate change	N	--	N	N	N
Others	--	N	--	--	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Human activities leading to climate changes that result in changes in water temperature, ocean currents, and fresh water input and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B20: Features of southwestern coast of the Gulf: Spawning of Atlantic mackerel

EBSA: 5 – South-western Coast of the Gulf (13,506 km²; 5.3% of the EGSL)

Scoping:

Nineteen (19) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Oil Spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Oxygen depletion	Temperature & salinity change	Increased UV radiation	Toxic algal blooms
Bottom trawl	--	N	--	--	--	--	--	--	--
Scallop dredge	--	N	--	--	--	--	--	--	--
Gillnet (bottom)	N	N	--	--	--	--	--	--	--
Longline	--	N	--	--	--	--	--	--	--
Jigging machine	N	N	--	--	--	--	--	--	--
Mackerel trap	N	N	--	--	--	--	--	--	--
Dredging	--	N	--	--	--	--	--	--	--
Vessel traffic	--	--	N	--	--	--	--	--	--
Industrial activities	--	--	--	N	N	--	--	--	--
Human induced climate change	--	--	--	--	--	N	N	N	--
Other fishing gear	N	--	--	--	--	--	--	--	--
Others: Discard at sea-bait	N	--	--	--	--	--	--	--	--
Others	--	--	--	--	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Habitat alterations caused by bottom trawling, scallop dredging, longline fishing and dredging do not overlap with the ecosystem component.

According to François Grégoire (DFO, pers. comm.), the landing data are not complete because mackerel fishing is not sufficiently regulated. The lack of the available information on both the spatial distribution of fisheries targeting this species and biomass removal do not allow a realistic assessment of undeclared discard at-sea, jigging machine, mackerel trapping or bait catches.

The impacts of oil spills from vessel traffic, and the impacts of persistent organic pollutants and chemical contaminants, and industrial effluents from industrial activities were not retained because the available information is inadequate to assess their effects on the spawning of mackerel.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Human activities leading to climate changes that result in changes in water temperature, ocean currents, and fresh water input and increased ultraviolet rays were not retained for the assessment. However, according to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B21: Features of southwestern coast of the Gulf: Historic spawning of southern Gulf Atlantic cod

EBSA: 5 – South-western Coast of the Gulf (13,506 km²; 5.3% of the EGSL)

For this ecosystem component, the three Regions contributing to the Working Group decided to consider eggs and adults present during cod spawning. Despite the negligible number of eggs observed in the last ten years, it is important to assess the potential harmful effect of activities on potential cod habitat. The area where cod eggs were reported from 1982 to 1986 used to represent the potential spawning habitat in EBSA 5, assuming that broodstock were present throughout the area during that period.

Scoping:
Twenty (20) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/ stressors	Biomass removal	Habitat alteration	Noise & disturbance	Ghost nets	Oil spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluent	Oxygen depletion	Temperature & salinity change	Increased UV radiation	Toxic algal blooms
Bottom trawl	N	N	–	–	–	–	–	–	–	–	–
Scallop dredge	–	N	–	–	–	–	–	–	–	–	–
Gillnet (bottom)	N	N	–	N	–	–	–	–	–	–	–
Longline	N	N	–	–	–	–	–	–	–	–	–
Scottish and Danish seine	N	N	–	–	–	–	–	–	–	–	–
Handline	N	–	–	–	–	–	–	–	–	–	–
Dredging	–	N	–	–	–	–	–	–	–	–	–
Vessel traffic	–	–	–	–	N	–	–	–	–	–	–
Seismic surveys	–	–	N	–	–	–	–	–	–	–	–
Industrial activities	–	–	–	–	–	N	N	–	–	–	–
Human activity-induced climate change	–	–	–	–	–	–	–	N	N	N	–
Others	–	–	–	–	–	–	–	–	–	–	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The overlap is negligible between the ecosystem component and bottom trawling, scallop dredging, gillnets, longline, and Scottish and Danish seine in EBSA 5. There is no temporal overlap between the ecosystem component and handline fishing. The overlap between the ecosystem component and dredging is negligible.

The impacts of oil spills from vessel traffic, and the impacts of persistent organic pollutants and chemical contaminants, and industrial effluents from industrial activities were not retained because the available information is inadequate to assess their effects on the historic spawning of cod in the south, and in EBSA 5 there are few factories.

There are no plans for seismic exploration in the Gulf Region, and none has taken place in the last five years. Given the uncertainty surrounding the impacts of noise and disturbances as well as the low probability of seismic surveys being conducted in Channel # 2 (non-priority) within the next ten years, this activity was not retained.

Human activities leading to climate changes that result in changes in water temperature, ocean currents, and fresh water input and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B22: Features of southwestern coast of the Gulf: Abundant eggs and larvae from different organisms

EBSA: 5 – South-western Coast of the Gulf (13,506 km²; 5.3% of the EGSL)

Scoping:
Thirteen (13) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Oil spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluent	Sewage	Nutrient input	Oxygen depletion	Change in freshwater input	Toxic algal blooms	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Industrial activities	N	N	N	–	–	–	–	–	–	–	–	–	–
Human settlement	–	–	–	N	N	N	–	–	–	–	–	–	–
Human activity-induced climate change	–	–	–	–	–	–	N	N	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Both the Restigouche/Baie des Chaleurs and Miramichi River/Estuary systems drain areas of the provinces of New Brunswick and Québec in which forestry, mining, pulp and paper mills, and thermal generating stations have contributed significantly to the pollution of coastal and nearshore waters. Northeast New Brunswick is also the home of the country's largest reserves of agricultural peat moss. It is worthy to note that fish plants abound on the Acadian Peninsula in particular, but also at frequent intervals along this coast. While the concerns for these kinds of impacts are valid and worthy of monitoring, in addition to being associated with coastal areas (outside of the EBSA), there is no evidence that they have acted in concert at the ecological level to cause any significant reduction in the overall abundance of fish eggs and larvae.

Concerns with human settlement include a number of related stressors: sewage, nutrient input, and oxygen depletion. It is conceivable that such changes will have a negative impact on overall abundance of eggs and larvae; however these stressors are often associated with coastal areas located outside of the EBSA.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B23: Features of southwestern coast of the Gulf: Benthic invertebrates (starfish, basket stars, *Eualus macilentus*, *Pandalus borealis*, *Pandalus montagu*, sponges, anemones, urchins, snow crab, ascidians, whelks, sea scallops, Icelandic scallops, *E. fabrici*, *Spirontocaris spinus*, *Lebbeus polaris*, *Sabiena septemcarinata*, *Argis dentate*, Arctic lyre crab, squid, Atlantic octopus)

EBSA: 5 – South-western Coast of the Gulf (13,506 km²; 5.3% of the EGSL)

Scoping:
Fourteen (14) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/ stressors	Biomass removal	Habitat alteration	Ghost nets	Oil spills/pollution	Temperature & salinity change
Bottom trawl	–	Y	–	--	–
Scallop dredge	Y	Y	–	--	–
Gillnet (bottom)	–	Y	Y	--	–
Gillnet (pelagic)	–	N	N	--	–
Longline	–	Y	–	--	–
Pots (crabs, lobsters...)	Y	Y	Y	--	–
Dredging	–	N	–	--	–
Vessel traffic	–	--	–	N	–
Human activity-induced climate change	–	--	–	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – The overlap between the range of benthic invertebrates and dredging is negligible.

The impacts of oil spills from vessel traffic were not retained because the available information is inadequate to assess their effects on the benthic invertebrates.

Human activities leading to climate changes that result in changes in water temperature were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Bottom trawling, scallop dredging, gillnets, longline and traps were included, particularly because they cause habitat alterations. Scallop dredging and traps also lead to biomass removal. Finally, nets and ghost fishing were assessed for gillnets and traps, respectively.

Appendix B24: Features of southwestern coast of the Gulf: Overwinter for southern Gulf juvenile herring

EBSA 5 – South-western Coast of the Gulf (13,506 km²; 5.3% of the EGSL)

Scoping:
Seventeen (17) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ghost nets	Change in freshwater input	Ocean acidification	Ice distribution	Temperature & salinity change	Sea-level rise	Change in ocean currents	Increased storms & surges	Increased UV radiation
Bottom trawl	N	--	--	--	--	--	--	--	--	--	--
Scallop dredge	N	N	--	--	--	--	--	--	--	--	--
Gillnet (bottom)	N	--	N	--	--	--	--	--	--	--	--
Gillnet (pelagic)	N	--	N	--	--	--	--	--	--	--	--
Scottish/Danish seine	N	--	--	--	--	--	--	--	--	--	--
Purse seine	Y	--	--	--	--	--	--	--	--	--	--
Human activity-induced climate change	--	--	--	N	N	N	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Gear restrictions are such that by-catch of juvenile herring should be minimal. Only a small part of EBSA 5 is subject to trawling and this gear is not considered further for analysis. There are no reported by-catches of pelagic species in scallop drags. Although scallop drags are damaging to benthic habitat, the extent of scallop dragging in EBSA 5 is limited. License conditions have mesh size restrictions, which limit the by-catch of juvenile herring. The ghost nets created by bottom gillnets do not pose a threat for the same reasons. None to negligible amounts of juvenile herring are caught in gillnet (pelagic) fisheries, which do not take place during the overwintering period. If a risk of ghost fishing exists, it is less than that of the fishery. Mesh size restrictions limit the catchability of small fish in Scottish/Danish seine fishery, therefore it is expected that effects to juvenile herring are minimal.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – The purse seine fleet is allocated 23% of the Total Allowable Catch (TAC). It harvests a significant amount of juvenile herring from the spring spawner component of the fishery, while catches of juveniles from the fall spawner component are low. Despite the fact that these fisheries occur before and after the period of overwintering, the fact that they entrap a significant number juveniles determines that this gear represents a threat to overwintering juveniles.

Appendix B25: Features of southwestern coast of the Gulf: Shelter, feeding and spawning for pelagic fish (southern Gulf herring, alewife, spiny dogfish, capelin, mackerel, rainbow smelt)

EBSA 5 – South-western coast of the Gulf (13,506 km²; 5.3% of the EGSL)

Scoping:
Twenty six (26) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Ghost nets	Persistent organic pollutants & chemical contaminants	Industrial effluent	Sewage	Nutrient input	Sedimentation	Oxygen depletion	Ocean acidification	Ice distribution	Temperature & salinity change	Sea-level rise	Change in ocean currents	Increased storms & surges	Increased UV radiation
Bottom trawl	Y	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Scallop dredge	N	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Midwater trawl	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Gillnet (bottom)	N	–	N	–	–	–	–	–	–	–	–	–	–	–	–	–
Gillnet (pelagic)	Y	–	N	–	–	–	–	–	–	–	–	–	–	–	–	–
Longline	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Scottish/Danish seine	N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Purse seine	Y	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Industrial activities	–	–	–	N	N	–	–	N	–	–	–	–	–	–	–	–
Human settlement	–	–	–	–	–	N	N	–	N	–	–	–	–	–	–	–
Human activity-induced climate change	–	–	–	–	–	–	–	–	N	N	N	N	N	N	N	N

Y = Activity/Stressor screened in; N = Activity/Stressor screened out;
– = Irrelevant

Excluded – The habitat of these pelagic species do not seem to be directly affected by bottom trawls perhaps due to their migratory patterns and their reliance on pelagic than benthic feeding. There are no reported by-catches of pelagic fish by scallop drags. Though the area coinciding with the spawning grounds for herring and mackerel is regularly raked by scallop drags, both are robust species with extensive spawning and nursery grounds throughout the remainder of EBSA 5 and neither population seems to be affected by this activity. Mid-water trawls are not used in this EBSA. Bottom gillnets tend to target only groundfish species and do not intercept pelagic species. Similarly, bottom gillnet ghost nets normally sink to the bottom and do not pose a threat to pelagic species. Pelagic gillnet ghost nets sink to the bottom and are unlikely to constitute a significant threat. There is no directed longline fishery for spiny dogfish and this fishing technique is not considered to pose a serious risk to the other species in this ecosystem component. Scottish/Danish seines are not used in this EBSA. Pelagic species are generally short lived and do not tend to accumulate POPs or inorganic contaminants that will affect them directly in their lifetime. There has not been any major contamination event in this area in the last three decades. Because the EBSA is not located near the coast, the stressors associated with human settlement pose no evident risk.

The stressors associated with human-induced climate changed have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Bottom trawls may capture pelagic species especially when used in shallower waters. Therefore this gear does present a potential risk to the summer feeding pattern of at least some of the species and is retained for further analysis. Fixed pelagic gillnets are an effective means of capture for most pelagic species. During the feeding period, pelagic gillnets would most likely take a combination of these species. Most of the species considered here are the intended target of the purse seine fishery. As such, they are not only vulnerable to but specifically sought after. This gear is used in a large part of EBSA 5, particularly in areas of known concentration of herring and mackerel for spawning and nursery functions.

Appendix B26: Features of southwestern coast of the Gulf: Important feeding area for marine mammal including North Atlantic right whale and blue whales

EBSA 5 – South-western coast of the Gulf (13,506 km²; 5.3% of the EGSL)

Scoping:
Fifteen (15) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/ stressors	Noise & disturbance	Ship strikes	Entanglement	Ghost nets	Oil spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluent	Toxic algal blooms
Gillnet (bottom)	–	–	--	Y	–	–	--	–
Pots (crabs, lobster…)	–	–	Y	Y	--	–	--	–
Aquaculture	N	–	--	–	--	–	--	–
Ecotourism	Y	Y	–	–	--	–	--	–
Vessel traffic	Y	Y	–	–	Y	–	--	–
Ballast water exchange	–	–	--	–	--	–	--	N
Seismic surveys	N	–	--	–	--	–	--	–
Industrial activities	–	–	--	–	--	N	N	–
Other : Scientific research	N	–	--	–	--	–	--	–

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The main impact of aquaculture on this ecosystem component is noise, as some salmon mariculture sites use high-amplitude acoustic harassment devices. All aquaculture sites In EBSA 5 are used to raise shellfish, and these devices are not used.

Ballast water is considered one of the main vectors for introducing invasive and potentially toxic species. However, the impact of toxic algal blooms is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems.

The oil and gas industry uses compressed air guns to conduct seismic exploration. This creates noise that disturbs marine mammals. This activity was not retained because a scientific assessment of the impact of seismic noise on various species concluded that the impacts were uncertain. In addition, the probability is low that seismic surveys will commence within the next ten years in this non-priority channel.

Industrial activities were not retained because marine mammals do not appear to be significantly affected by the impacts of persistent organic pollutants, contaminants or industrial effluents, given their low concentrations in the trophic chain. Harbour seals, however, may be at slightly higher risk, because they inhabit this EBSA and eat fish. Some contaminants may alter the reproductive potential and the health of cetaceans, but it is very difficult to assess these impacts. Finally there are few plants near the areas where marine mammals concentrate in this EBSA.

Scientific research may disturb cetaceans and prevent them from carrying out their essential daily life processes or cause them stress. However, this activity was not retained because the type of research conducted (photo-identification) does not cause significant disturbance, and very little research is conducted in EBSA 5.

Included – Activities involving gillnets and pots as well as ecotourism and vessel traffic were retained mainly due to the potential for entanglement in fishing gear and the disturbance and noise impacts in the case of vessel traffic.

Appendix B27: Features of Lower Estuary: Phytoplankton (upwelling)

EBSA 6 – Lower Saint-Lawrence Estuary (9,046 km²; 3.5 % EGSL).

Scoping:
Five (5) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Sedimentation	Ice distribution	Change in ocean current	Increased UV radiation	Toxic algal blooms
Dredging	N	--	--	--	--
Human activity-induced climate change	--	N	N	N	--
Others	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The impact of dredging on phytoplankton relates mainly to turbidity in the water column. This activity was not retained because the phytoplankton bloom is very concentrated in spring but weaker in summer, fall and winter. In addition, there are few dredging sites in this EBSA and the overlap between disposal sites and the range of phytoplankton species not significant.

Human activities leading to climate changes that result in changes in water temperature, ocean currents, and fresh water input and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B28: Features of Lower Estuary: Zooplankton (CIL and Atlantic)

EBSA 6 – Lower St-Lawrence Estuary (9,046 km²; 3.5 % EGSL).

Scoping:
Five (5) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Change in freshwater input	Temperature & salinity change	Change in ocean currents	Increased UV radiations	Toxic algal blooms
Human activity-induced climate change	N	N	N	N	--
Others	–	–	–	–	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Human activities leading to climate changes that result in changes in water temperature, ocean currents, and fresh water input and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B29: Features of Lower Estuary: Juvenile groundfish (juvenile turbot, witch flounder, thorny skate)

EBSA 6 – Lower St-Lawrence Estuary (9,046 km²; 3.5 % EGSL)

Scoping:
Eleven (11) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Habitat alteration	Noise & disturbance	Ghost nets	Oil spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluent	Temperature & salinity change
Bottom trawl	N	--	--	--	--	--	--
Scallop dredge	N	--	--	--	--	--	--
Gillnet (bottom)	N	--	N	--	--	--	--
Longline	N	--	--	--	--	--	--
Dredging	N	--	--	--	--	--	--
Vessel traffic	--	--	--	N	--	--	--
Seismic surveys	--	N	--	--	--	--	--
Industrial activities	--	--	--	--	N	N	--
Human activity-induced climate change	--	--	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The overlap between juveniles and mobile gear (i.e. scallop dredging and bottom trawl) and dredging is negligible. For gillnets, only habitat alteration was considered because juveniles are not harvested, however the impacts of pelagic gillnet fishing on the habitat are not known in this EBSA.

The impacts of oil spills from vessel traffic, and the impacts of persistent organic pollutants and chemical contaminants, and industrial effluents from industrial activities were not retained because the available information is inadequate to assess their effects on juvenile fishes in EBSA 6.

Human activities leading to climate changes that result in changes in water temperature were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – None.

Appendix B30: Features of Lower Estuary: Unique habitat for the resident population of St. Lawrence beluga

EBSA 6 – Lower Saint-Lawrence Estuary (9,046 km²; 3,5 % EGSL)

Scoping:
Fifteen (15) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Noise & disturbance	Ship strikes	Entanglement	Ghost nets	Oil spill/pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Toxic algal blooms
Gillnet (bottom)	–	--	N	N	--	--	–	--
Pots (crabs, lobsters...)	–	--	Y	Y	--	--	–	--
Aquaculture	N	--	–	–	--	--	–	--
Ecotourism	Y	Y	–	–	--	--	–	--
Vessel traffic	Y	Y	–	–	Y	--	–	--
Ballast water exchange	–	--	–	–	--	--	–	N
Seismic surveys	Y	--	–	–	--	--	–	--
Industrial activities	–	--	–	–	--	N	Y	--
Others : Scientific research	N	--	–	–	--	--	–	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – The impacts of entanglement by ghost and active gillnets on belugas was considered. This activity was not retained because very few cases have been reported, very few individuals bear scars caused by fishing gear, and accidental capture in fishing gear does not appear to be hindering beluga recovery in the Estuary and Gulf of St. Lawrence.

The main impact of aquaculture on this ecosystem component is noise, because high-amplitude acoustic harassment devices are used at some salmon mariculture sites. This activity was not retained because there are no aquaculture sites using high-amplitude acoustic harassment devices in EBSA 6.

Ballast water is considered one of the main vectors for introducing invasive and potentially toxic species. However, the impact of toxic algal blooms is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems.

Scientific research may disturb cetaceans and prevent them from carrying out their essential daily life processes or cause stress for individuals. This activity was not retained because, although three research stations are based in EBSA 6, only one group is studying belugas, and their activities are limited. In addition, the authorities of the Saguenay–St. Lawrence Marine Park oversee these activities by issuing licences and permits in their area (southern part of the EBSA), which limits disruptions and disturbances.

Included – Activities involving traps as well as ecotourism, vessel traffic, seismic surveys and industrial activities were retained mainly due to the potential for entanglement in fishing gear and the disturbance and noise impacts in the case of vessel traffic and seismic surveys.

Appendix B31: Features of Lower Estuary: Feeding area for numerous individual and marine mammal species

EBSA: 6 – Lower Saint-Lawrence Estuary (9,046 km²; 3,5 % EGSL)

Scoping:
Sixteen (16) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Noise & disturbance	Ship strikes	Entanglement	Ghost nets	Oil spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Toxic algal blooms	Invasive species
Gillnets (bottom)	--	--	Y	Y	--	--	--	--	--
Pots (crabs, lobsters...)	--	--	Y	Y	--	--	--	--	--
Aquaculture	N	--	--	--	--	--	--	--	--
Ecotourism	Y	Y	--	--	--	--	--	--	--
Vessel traffic	Y	Y	--	--	Y	--	--	--	--
Ballast water exchange	--	--	--	--	--	--	--	N	N
Seismic surveys	Y	--	--	--	--	--	--	--	--
Industrial activities	--	--	--	--	--	N	N	--	--
Others : Scientific research	N	--	--	--	--	--	--	--	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The impacts of entanglement by ghost and active gillnets on this ecosystem component was considered. This activity was not retained because very few cases have been reported, very few individuals bear scars caused by fishing gear, and accidental capture in fishing gear does not appear to be hindering marine mammal recovery in the Estuary and Gulf of St. Lawrence.

The main impact of aquaculture on this ecosystem component is noise, because high-amplitude acoustic harassment devices are used at some salmon mariculture sites. This activity was not retained because there are no aquaculture sites using high-amplitude acoustic harassment devices in EBSA 6.

Ballast water is considered one of the main vectors for introducing invasive and potentially toxic species. However, the impact of toxic algal blooms is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems.

Scientific research may disturb cetaceans and prevent them from carrying out their essential daily life processes or cause stress for individuals. This activity was not retained because, although three research stations are based in EBSA 6, only one group is studying marine mammals, and their activities are limited. In addition, the authorities of the Saguenay–St. Lawrence Marine Park oversee these activities by issuing licences and permits in their area (southern part of the EBSA), which limits disruptions and disturbances.

Included – Activities involving traps as well as ecotourism, vessel traffic, seismic surveys and industrial activities were retained mainly due to the potential for entanglement in fishing gear and the disturbance and noise impacts in the case of vessel traffic and seismic surveys.

Appendix B32: Features of Western Anticosti: Phytotplankton and zooplankton vertical mixing (gyre and Gaspe current)

EBSA 7 – Western Anticosti (3,822 km², 1.5 % EGSL)

Scoping:
Five (5) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Change in freshwater input	Temperature & salinity change	Change in ocean currents	Increased UV radiation	Toxic algal blooms
Human activity-induced climate change	N	N	N	N	--
Others	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Human activities leading to climate changes that result in changes in water temperature, ocean currents, and freshwater input and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B33: Features of Western Anticosti: Mesoplankton reproduction, recruitment, and retention

EBSA 7 – Western Anticosti (3,822 km², 1.5 % EGSL)

Scoping:
Five (5) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Change in freshwater input	Temperature & salinity change	Change in ocean currents	Increased UV radiation	Toxic algal blooms
Human activity-induced climate change	N	N	N	N	--
Others	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Human activities leading to climate changes that result in changes in water temperature, ocean currents, and freshwater input and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B34: Features of Western Anticosti: Cod and American plaice eggs

EBSA 7 – Western Anticosti (3,822 km², 1.5 % EGSL)

Scoping:
Fourteen (14) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Habitat alteration	Oil spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Oxygen depletion	Toxic algal blooms	Ice distribution	Temperature & salinity change	Change in ocean current	Increased UV radiation
Bottom trawl	Y	--	--	--	--	--	--	--	--	--
Scallop dredge	N	--	--	--	--	--	--	--	--	--
Gillnet	Y	--	--	--	--	--	--	--	--	--
Longline	Y	--	--	--	--	--	--	--	--	--
Dredging	N	--	--	--	--	--	--	--	--	--
Vessel traffic	--	N	--	--	--	--	--	--	--	--
Industrial activities	--	--	N	N	--	--	--	--	--	--
Human activity-induced climate change	--	--	--	--	N	--	N	N	N	N
Others	--	--	--	--	--	N	--	--	--	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The overlap between cod and American plaice eggs and scallop dredging is negligible in this EBSA. There are no reported dredging or sea disposal sites in EBSA 7.

The impacts of oil spills from vessel traffic, and the impacts of persistent organic pollutants and chemical contaminants, and industrial effluents from industrial activities were not retained because the available information is inadequate to assess their effects.

Human activities leading to climate changes that result in changes in ice distribution, water temperature, ocean currents, in oxygen depletion and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – Bottom trawling, gillnet fishing and longline fishing are largely retained, particularly because they alter habitats.

Appendix B35: Features of Western Anticosti: Larvae richness of Sand lance (*Ammodytes* spp.), Arctic shanny (*Stichaeus punctatus*) and of decapods crustaceans (Snow crab, Arctic lyre crab., Northern shrimp and Striped pink shrimp)

EBSA: 7 – Western Anticosti Island (3,822 km², 1.5 % EGSL)

Scoping:
Twelve (12) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Habitat alteration	Oil spills/pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Oxygen depletion	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiations	Toxic algal blooms
Bottom trawl	N	--	--	--	--	--	--	--	--	--
Scallop dredge	N	--	--	--	--	--	--	--	--	--
Dredging	N	--	--	--	--	--	--	--	--	--
Vessel traffic	--	N	--	--	--	--	--	--	--	--
Industrial activities	--	--	N	N	--	--	--	--	--	--
Human activity-induced climate change	--	--	--	--	N	N	N	N	N	--
Others	--	--	--	--	--	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – There is no horizontal (i.e., areal extent) or vertical (i.e., contact) overlap between fishing gear such as bottom trawls, scallop dredging and longlines and the ecosystem component of the larvae of the sandlance, the Arctic shanny or decapod crustaceans in EBSA 7. There are no reported dredging or sea disposal sites in EBSA.

The impacts of oil spills from vessel traffic, and the impacts of persistent organic pollutants and chemical contaminants, and industrial effluents from industrial activities were not retained because the available information is inadequate to assess their effects on fish larvae and decapod crustaceans.

Human activities leading to climate changes that result in changes in ice distribution, water temperature, ocean currents, in oxygen depletion and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B36: Features of Western Anticosti: Invertebrates (Icelandic scallop, green sea urchin, sea cucumber, sponges, starfish, basket stars, brittle stars, hermit crabs, decapod crustaceans, shrimp (*Lebbeus groenlandicus*, *L. microceros*, *Eualus gaimardii betcher* and several other shrimp species), sepiola, jellyfish

EBSA 7 – Western Anticosti (3,822 km², 1.5 % EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Biomass removal	Habitat alteration	Ghost nets	Oil spills & pollution	Temperature & salinity change
Bottom trawl	--	Y	--	--	--
Scallop dredge	Y	N	--	--	--
Gillnet (bottom)	--	Y	Y	--	--
Longline	--	Y	--	--	--
Dredging	--	N	--	--	--
Vessel traffic	--	--	--	N	--
Human activity-induced climate change	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The overlap between benthic invertebrates and scallop dredging is negligible in this EBSA. There are no reported dredging or sea disposal sites in EBSA 7.

The impacts of oil spills from vessel traffic were not retained because the available information is inadequate.

Human activities leading to climate changes that result in changes in water temperature were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Bottom trawling, gillnet fishing and longline fishing were retained, mainly because they alter the habitat. The impacts of gillnet ghost nets were also included.

Appendix B37: Features of Northern Anticosti: Egg richness of Atlantic cod and American plaice

EBSA 8 – Northern Anticosti (7,620 km², 3 % EGSL)

Scoping:
Fourteen (14) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Habitat alteration	Oil spills & pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Oxygen depletion	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation	Toxic algal blooms
Bottom trawl	Y	–	--	–	--	–	--	–	--	--
Scallop dredge	Y	–	--	–	--	–	--	–	--	--
Gillnet	N	–	--	–	--	–	--	–	--	--
Longline	Y	–	--	–	--	–	--	–	--	--
Dredging	N	–	--	–	--	–	--	–	--	--
Vessel traffic	–	N	--	–	--	–	--	–	--	--
Industrial activities	–	–	N	N	--	–	--	–	--	--
Human activity-induced climate change	–	–	--	–	N	N	N	N	N	--
Others	–	–	--	–	--	–	--	–	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – The overlap between the ecosystem component and gillnets is negligible. There are no reported dredging or sea disposal sites in EBSA 8.

Vessel traffic activities were not retained because the available information on the impacts of oil spills and persistent organic pollutants and contaminants is inadequate to assess the impacts on cod and American plaice eggs.

Human activities leading to climate changes that result in changes in ice distribution, water temperature, ocean currents, in oxygen depletion and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade. Without this information, it is currently impossible to quantify the impact of this activity on this ecosystem component in EBSA 8.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – Bottom trawling, scallop dragging and longline fishing were retained, mainly because they alter the habitat.

Appendix B38: Features of Northern Anticosti: Richness of Sand lance (*Ammodytes* spp.) and Arctic shanny (*Stichaeus punctatus*) larvae, and decapod crustaceans (Snow crab, Arctic lyre crab, Northern shrimp and Striped pink shrimp)

EBSA 8 – Northern Anticosti (7,620 km², 3 % EGSL)

Scoping:
Twelve (12) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Habitat alteration	Oil spills/pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Oxygen depletion	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation	Toxic algal blooms
Bottom trawl	N	–	–	--	–	--	–	–	--	–
Scallop dredge	N	–	–	--	–	--	–	–	--	–
Dredging	N	–	–	--	–	--	–	–	--	–
Vessel traffic	–	N	–	--	–	--	–	–	--	–
Industrial activities	–	–	N	N	–	--	–	–	--	–
Human activity-induced climate change	–	–	–	--	N	N	N	N	N	–
Others	–	–	–	--	–	--	–	–	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – There is no horizontal (i.e., areal extent) or vertical (i.e., contact) overlap between fishing gear such as bottom trawls, scallop dredging and longlines and the larvae of sand lance, Arctic shanny or decapod crustaceans in EBSA 8. There are no reported dredging or sea disposal sites in EBSA 8.

The impacts of oil spills from vessel traffic, and the impacts of persistent organic pollutants and chemical contaminants, and industrial effluents from industrial activities were not retained because the available information is inadequate to assess their effects on fish larvae and decapod crustaceans.

Human activities leading to climate changes that result in changes in ice distribution, water temperature, ocean currents, in oxygen depletion and increased ultraviolet rays were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

The impact of toxic algal blooms (activity: Other) is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems. This impact is therefore considered natural and non-anthropogenic, and was not retained.

Included – None.

Appendix B39: Features of Northern Anticosti: Invertebrates (Icelandic scallop , green sea urchin, sea cucumber, sponges, starfish, basket stars, brittle stars, hermit crabs, decapod crustaceans, shrimp (*Lebbeus groenlandicus*, *L. microceros*, *Eualus gaimardii betcheri* and several other shrimp species), sepiola, jellyfish

EBSA 8 – Northern Anticosti (7,620 km², 3% EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Biomass removal	Habitat alteration	Ghost nets	Oil spills & pollution	Temperature & salinity change
Bottom trawl	--	Y	--	--	--
Scallop dredge	Y	Y	--	--	--
Gillnet (Bottom)	--	Y	Y	--	--
Longline	--	Y	--	--	--
Dredging	--	N	--	--	--
Vessel traffic	--	--	--	N	--
Human activity-induced climate change	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – There are no reported dredging or sea disposal sites in EBSA 8.

The impacts of oil spills from vessel traffic were not retained because the available information is inadequate.

Human activities leading to climate changes that result in changes in water temperature were not retained for the assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included – Bottom trawling, scallop dragging and longline fishing were retained, mainly because they alter the habitat. Scallop dredging also includes the impact of biomass removal. Finally, gillnet ghost nets were assessed.

Appendix B40: Features of Northern Anticosti: Cetacean aggregation (fin whales, blue whales, humpback whales and harbour porpoise)

EBSA 8 – Northern Anticosti (7,620 km², 3 % EGSL)

Scoping:
Sixteen (16) activities/stressors identified as potentially affecting this group were initially analysed:

Activities/stressors	Noise & disturbance	Ship strikes	Entanglement	Ghost nets	Oil spills/pollution	Persistent organic pollutants & chemical contaminants	Industrial effluents	Invasive species
Gillnets (bottom)	--	--	Y	Y	--	--	--	--
Pots (crabs, lobsters...)	--	--	Y	Y	--	--	--	--
Aquaculture	N	--	--	--	--	--	--	--
Ecotourism	Y	Y	--	--	--	--	--	--
Vessel traffic	Y	Y	--	--	Y	--	--	--
Ballast water exchange	--	--	--	--	--	--	--	N
Seismic surveys	N	--	--	--	--	--	--	--
Industrial activities	--	--	--	--	--	N	N	--
Others : Scientific research	N	--	--	--	--	--	--	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Exluded – The main impact of aquaculture is noise, because high-amplitude acoustic harassment devices are used at some salmon mariculture sites. In EBSA 8, the only aquaculture site is used to raise shellfish, and it does not use this type of device.

Ballast water is considered one of the main vectors for introducing invasive and potentially toxic species. However, the impact of toxic algal blooms is difficult to assess due to its natural presence and the inter-annual variability of its impacts on marine ecosystems.

The oil and gas industry uses compressed air guns to conduct seismic exploration. This creates noise that disturbs marine mammals. This activity was not retained because a scientific assessment of the impact of seismic noise on various species concluded that the impacts were uncertain. In addition, the probability is low that seismic surveys will commence within the next ten years in this non-priority channel.

Industrial activities were not retained because marine mammals do not appear to be significantly affected by the impacts of persistent organic pollutants, contaminants or industrial effluents, given their low concentrations in the trophic chain. Some contaminants may alter the reproductive potential and the health of cetaceans, but it is very difficult to assess these impacts. Finally there are few plants near the areas where marine mammals concentrate in this EBSA.

Scientific research may disturb cetaceans and prevent them from carrying out their essential daily life processes or cause stress for individuals. This activity was not retained because only a few research groups are based in EBSA 8, and the impact is negligible.

Included – Activities involving gillnets and pots as well as ecotourism and vessel traffic were retained mainly due to the potential for entanglement in fishing gear and the disturbance and noise impacts in the case of vessel traffic.

Appendix B41: Features and Species of Strait of Belle Isle: Benthic invertebrates (*Lebbeus groenlandicus*, *Eualus gaimardii belcheri*, *E. gaimardii gaimardii*, ascidians, starfish, basket stars, *Sclérocrangon boreal*, *E. fabricii*, *E. macilentus*, *S. spinus*, *L. polaris*, *Pandalus montagui*, *Sabinea septemcarinata*, *Argis dentate*, *L. microceros*), sepiola

EBSA: 9 – Strait of Belle Isle including Mecatina Trough (7,403 km², or 2.9% of the EGSL)

Scoping:
Twelve (12) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Fish plant offal	Oxygen depletion	Ice distribution	Temperature & salinity change	Sea-level rise	Change in ocean currents
Bottom trawl	--	N	--	--	--	--	--	--
Scallop dredge	Y	Y	--	--	--	--	--	--
Fish processing	--	--	N	--	--	--	--	--
Dredging	--	N	--	--	--	--	--	--
Sub-marine cables	--	N*	--	--	--	--	--	--
Marine construction (ex. Dykes, breakwaters, wharves)	--	N	--	--	--	--	--	--
Human activity-induced climate change	--	--	--	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
* See notes in profile
-- = Irrelevant

Excluded – Bottom trawling for shrimp is very limited or non-existent in this EBSA. Fish offal dumping is limited to two localized sites and subject to CEPA site selection process. The list of annual dredging sites by DFO does not include any for Straits area. Marine construction sites being carefully assessed and monitored are not considered key stressor in this area. The Strait of Belle and Mecatina Trough are considered to be very dynamic areas with respect to ocean currents, ice distribution, water temperature and oxygen content, experiencing wide annual variation. However, the influence of human-induced climate change on these parameters would be difficult to determine and based on current predictions are not be expected to occur within the next 10 years.

Included – Scallop dredging (biomass removal and habitat alteration) and sub-marine cables were **screened in**. There is a large Icelandic scallop aggregation in this area that has been fished extensively since 1969. Scallop dredges have been shown to have long term impacts on benthic communities and their habitat.

Submarine cables linking Labrador with rest of Province is proposed for the area and could result in redistribution of bottom sediments affecting benthic invertebrates and their habitat.

Appendix B42: Features and Species of Strait of Belle Isle: Herring spawning

EBSA 9 – Strait of Belle Isle including Mecatina Trough (7,403 km², or 2.9% of the EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Noise & disturbance	Oil spills & pollution	Oxygen depletion	Temperature & salinity change	Change in ocean currents
Gillnet (pelagic)	Y	--	--	--	--	--	--
Purse seine	N	--	--	--	--	--	--
Sub-marine cables	--	N	--	--	--	--	--
Vessel traffic	--	--	N	N	--	--	--
Seismic surveys	--	--	N	--	--	--	--
Human activity-induced climate change	--	--	--	--	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Purse seine was screened out because the areal extent of all seines amounted to only 0.6% of the EBSA. Vessel traffic can be heavy at times throughout the year, but there is no evidence to suggest that vessel traffic noise it is a key stressor to herring spawning. There is always concern for the potential of oil spills from vessel traffic especially in the in the Straits area where the strong currents can disperse it rapidly. However, because the Strait is a secondary shipping lane and that herring spawning occurs over a limited time, this stressor ranked too low to be included.

Seismic surveys are considered unlikely to pose a high risk of mortality to marine organisms. The Strait of Belle and Mecatina Trough are considered to be very dynamic areas with respect to ocean currents, ice distribution, water temperature and oxygen content, experiencing wide annual variation. However, the influence of human-induced climate change on these parameters would be difficult to determine and based on current predictions are not be expected to occur within the next 10 years.

Included – Gillnet was screened in as it is a source of biomass removal.

Appendix B43: Features and Species of Strait of Belle Isle: Pelagic species (spiny dogfish, sand lance, capelin)

EBSA 9 – Strait of Belle Isle including Mecatina Trough (7,403 km², or 2.9% of the EGSL)

Scoping:
Eleven (11) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Noise & disturbance	Oil spills & pollution	Oxygen depletion	Temperature & salinity change	Change in ocean currents
Bottom trawl	N	--	--	--	--	--	--
Gillnet (pelagic)	Y	--	--	--	--	--	--
Purse seine	N	--	N	--	--	--	--
Sub-marine cables	--	N	--	--	--	--	--
Vessel traffic	--	--	N	N	--	--	--
Seismic surveys	--	--	N	--	--	--	--
Human activity-induced climate change	--	--	--	--	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Shrimp trawl activity in areas of pelagic aggregations (ex for feeding) could be disruptive especially if it is a relatively confined area such as the Straits of Belle Isle. However, given that shrimp trawling is currently limited to the head of the Esquiman Channel, it is not a concern for pelagic aggregations in Isle EBSA 9.

Purse seine was screened out because the areal extent of all seines amounted to only 0.6% of the EBSA.

Vessel traffic can be heavy at times throughout the year, but there is no evidence to suggest that it is a key stressor to pelagic species, except in the case of oil spills where strong currents in the in the Straits area can disperse it rapidly.

Herring spawning might be one component of the ecosystem component which may be affected by oil spills, but because the Strait is a secondary shipping lane and spawning occurs in a limited time, this stressor ranked too low to be included.

Seismic surveys, in general are considered unlikely to pose a high risk of mortality to marine organisms. The Strait of Belle and Mecatina Trough are considered to be very dynamic areas with respect to ocean currents, ice distribution, water temperature and oxygen content, experiencing wide annual variation. However, the influence of human-induced climate change on these parameters would be difficult to determine and based on current predictions are not be expected to occur within the next 10 years.

Included – Gillnet was screened in as it is a source of biomass removal.

Appendix B44: Features and Species of Strait of Belle Isle: Large cetaceans

EBSA 9 – Strait of Belle Isle including Mecatina Trough (7,403 km², or 2.9% of the EGSL)

Large cetaceans in the area include the following Mysticeti species: fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*), and northern right whale (*Eubalaena glacialis*). These are either currently at risk or have been considered as such in the past. The northern right whale is generally found in the Bay of Fundy and the Gulf of Maine. However, since 1995, right whale sightings have been increasing in the St. Lawrence. Large cetaceans also include one Odontoceti species: Sperm whale *(Physeter catadon)*. The Strait of Belle Isle has currents and tides that favor concentrations of krill, thus attracting many cetaceans for feeding. Humpbacks have been observed in the GSL between April and the beginning of January, with a peak between May and October.

Scoping:
Eleven (11) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Noise/Disturbance	Ship strikes & collisions	Entanglement	Persistent organic pollutants & chemical contaminants
Bottom trawl	--	--	N	--
Gillnet (bottom)	--	--	Y	--
Purse seine	--	--	N	--
Crab pots	--	--	N	--
Lobster pots	--	--	N	--
Whelk pots	--	--	N	--
Sub-marine cables	N	--	--	--
Vessel traffic	Y	Y	--	--
Seismic surveys	N	--	--	--
Industrial activities	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – All of the activities were considered for their potential for entanglement, noise disturbance or pollution. Most of these were screened out either because of limited activity in the area or because their location and timing were unlikely to coincide with presence of cetaceans.

Included – Gillnets are screened in as they are a main source of entanglement. Vessel traffic is relatively heavy through ice-free months and can result in ship strikes/collisions as well as creating noise resulting in disturbance.

Appendix B45: Features and Species of Strait of Belle Isle: Piscivorous (fish eating) and opportunistic marine mammal species

EBSA 9 – Strait of Belle Isle (7,403 km², or 2.9% of the EGSL)

Scoping:
Piscivorous (*fish consumers)* include beluga whale, harp seal, short-beaked common dolphins, white-beaked dolphins, Atlantic white-sided dolphins, and harbour porpoises. Harp and hooded seals are migratory species whereas the harbour and grey seal are year–round residents of the St. Lawrence but are not common in this EBSA. *Opportunistic feeders* include mainly those Balaenopteridae, whose diets vary between zooplankton and fish depending on areas or time of the year (i.e., fin, minke, and humpback whales). This category is mainly reflective of whales but also includes harp seals, whose diet is composed of invertebrates and fish.

Nine (9) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Noise & disturbance	Ship strikes & collisions	Entanglement	Persistent organic pollutants & chemical contaminants
Bottom trawl	–	–	–	N	–
Gillnet (bottom)	–	–	–	Y	–
Purse seine	–	–	–	N	–
Seal hunt	N	–	–	–	–
Sub-marine cables	–	N	–	–	–
Vessel traffic	–	Y	Y	–	–
Seismic surveys	–	N	–	–	–
Industrial activities	–	–	–	–	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Most of the activities/stressors were screened out either because of limited activity in the area or because their location and timing were unlikely to coincide with presence of marine mammals. A commercial seal hunt is carried out in the area but is well managed to ensure the population replaces itself and the hunt is not known to have an effect on other marine species in the area.

Included – Gillnets and vessel traffic were screened in for risk of harm characterization. Gillnets because they are a continuing source of entanglement for many marine mammal species and vessel traffic because it is relatively heavy through ice-free months and can result in ship strikes/collisions as well as creating noise resulting in disturbance.

Appendix B46: Features of West Coast of Newfoundland: Spawning of northern Gulf cod stock

EBSA 10 – West coast of Newfoundland (18,238 km²; 7.1% of the EGSL)

Scoping:
Nine (9) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Noise & disturbance	Ghost nets	Temperature & salinity change	Current Shifts
Bottom trawl	N	N	--	--	--	--
Gillnet (bottom)	Y	--	--	Y	--	--
Longline	Y	--	--	--	--	--
Purse seine	N	--	--	--	--	--
Seismic surveys	--	--	N	--	--	--
Human activity-induced climate change	--	--	--	--	N	N

Y = Activity/Stressor screened in;
N = Activity/Stressor screened out;
-- = Irrelevant

Excluded – Because cod landings from bottom trawl and shrimp trawl are minimal, and a closed area has been established in Bay St. George/Port au Port area, the main spawning area for cod in Division 4R to protect cod spawning during the most vulnerable time, bottom trawl is not expected to be a key stressor to cod spawning in this EBSA. Even if cod stocks recover, recent concern over benthic habitat alteration means that trawling is probably unlikely to be reinstated in its past form.

Over the period 1999-2008, there were no reported Atlantic cod landings with purse seine in the EBSA.

Seismic exploration, with mitigation measures in place (ex. avoidance of spawning areas), is generally considered unlikely to pose high risk spawning cod.

These responses of cod to future climate changes are highly uncertain, however, as they will also depend on the changes to climate and oceanographic variables besides temperature, such as plankton production, the prey and predator fields and industrial fishing. Temperature changes are not likely to be significant over the next 10 years.

Included – Gillnetting (biomass removal and ghost nets) and longlining (biomass removal) were screened in.

Appendix B47: Features of West Coast of Newfoundland: Fish larvae (capelin, herring)

EBSA 10 – West coast of Newfoundland (18,238 km²; 7.1% of the EGSL)

Scoping:
Fish larvae, particularly capelin and herring, are found in significant quantities in the coastal region north of the Port au Port Peninsula (DFO 2009 CSAS Science Advisory Report 2009/049).

Fifteen (15) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Oil spills/ pollution	Persistent organic pollutants & chemical contaminants	Sewage	Nutrient input	Eutrophication	Oxygen depletion	Toxic algal blooms	Parasites & diseases	Ocean acidification	Ice distribution	Temperature & salinity change	Change in ocean currents	Increased UV radiation
Ballast water exchange	N	--	--	N	--	--	N	N	--	--	--	--	--
Seismic surveys	--	--	--	--	--	--	--	--	--	--	--	--	--
Industrial activities	--	--	--	--	--	--	--	--	--	--	--	--	--
Human settlement	N	N	N	N	N	N	--	--	--	--	--	--	--
Human activity-induced climate change	--	--	--	--	--	--	--	--	N	N	N	N	N
Other	--	--	--	--	--	--	--	--	--	--	--	--	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excludes – Ballast water exchange was screened because incidents are localized and have not been shown to affect fish larvae on a broad scale.

Human settlement was screened because extent of affected areas is minor compared to overall distribution of capelin and herring.

Climate change was screened out because these changes are expected to occur over a decadal scale and may be difficult to separate from stochastic annual fluctuations.

Included – None.

Appendix B48: Features of West Coast of Newfoundland: Over wintering for northern Gulf herring and capelin

EBSA 10 – West coast of Newfoundland (18,238 km²; 7.1% of the EGSL)

Scoping:
The Esquiman Channel is the only known over-wintering area for Northern Gulf herring and capelin (Head of the Channel).

Five (5) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Ice distribution	Temperature & salinity change	Change in ocean currents
Gillnet (pelagic)	N	–	–	–
Purse seine	N	–	–	–
Human activity-induced climate change	–	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Purse seine was screened out because, while seiners do follow the advancement of mixed spring and fall spawning schools along their feeding and over-winter routes, they do not occur over the winter months (Dec-Mar).

No capelin was caught with gillnet, and removals of herring by gillnets was only 8% of the total landings in 1999-2008. This is considered minimal compared to purse seine activity, and gillnets are used from May to October. Therefore, gillnets are expected to have minimal impact on overwintering capelin and herring.

Temperature and ocean current changes associated with climate change were screened out because while pelagic species are sensitive to annual fluctuations in these stressors, significant changes due to human-induced climate modification are not likely to be encountered in next ten years.

Included – None.

Appendix B49: Features of West Coast of Newfoundland: Pelagic feeding

EBSA 10 – west coast of Newfoundland (18,238 km²; 7.1% of the EGSL)

Scoping:
Seven (7) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Temperature & salinity change	Sea-level rise	Change in ocean currents
Bottom trawl	N	–	–	–
Gillnet (pelagic)	N	–	–	–
Purse seine	N	–	–	–
Other - Trap nets	N	–	–	–
Other - Tuck seine	N	–	–	–
Human activity-induced climate change	–	N	–	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Bottom trawling was screened out because, while shrimp trawls do catch often significant amounts of capelin, they are required to use the Nordmore Grate to limit by-catch and by-catch removals would be minimal compared with removals from directed fisheries.

In 2007, approximately 121 t of capelin were caught by shrimpers. Most of these catches were made in the Seven Islands shrimp fishery management area and not within the EBSA. It has been estimated that at the current catch level, fishing mortality probably has no noticeable effects on the capelin population in the Estuary and Gulf of St. Lawrence.

Gillnets were screened out because while, they overlap with the main feeding period (Sept-Nov) for herring, they account for only 1% of landings.

Landings of capelin using purse seine occur only in June when fish are spawning and not feeding. The most active herring feeding period is considered to be September to November. While there may be some localised disruption of feeding by the commercial purse seine fishery activity in the fall, the impact would be minimized somewhat by being on mixed stocks. In addition, it has been estimated that the main cause of mortality for capelin and herring in the northern Gulf of St. Lawrence is predation rather than fishing activity.

Trap nets and tuck seines were screened out because they target the spawning as opposed to the feeding population.

Temperature and ocean current associated with climate change were screened out because, while pelagic species are sensitive to annual fluctuations in these factors, significant changes due to human-induced climate modification are not likely in next ten years.

Included – None.

Appendix B50: Features of West Coast of Newfoundland: Groundfish (juvenile cod, redfish, American plaice, Atlantic wolfish)

EBSA 10 – West coast of Newfoundland (18,238 km²; 7.1% of the EGSL)

Scoping:
Ten (10) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Noise & disturbance	Oil spills & pollution	Fish plant offal	Sedimentation	Oxygen depletion	Temperature & salinity change	Invasive species
Bottom trawl	N	N	--	–	--	–	–	–	–
Fish processing	--	–	--	–	N	–	–	–	–
Dredging	--	N	--	–	--	N	–	–	–
Vessel traffic	--	–	--	Y	--	–	–	--	N
Seismic surveys	--	–	N	–	--	–	–	–	–
Human activity-induced climate change	--	–	--	–	--	–	N	N	–

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Bottom trawling operations, for practical reasons, tend to avoid nearshore habitats (ex.: rocky areas) and it has been all but eliminated in the west coast fisheries. Even if cod stocks recover, recent concern over benthic habitat alteration means that trawling is probably unlikely to be reinstated in its past form.

Since the 1990s, shrimp trawls have been required to use the Nordmore Grate to limit by-catch of juveniles (ex. redfish). This management measure is expected to stay in place for the next ten years.

For fish offal dumping, the CEPA site selection process avoids sensitive habitats and ensures selection of dispersive environment for dumping. Therefore, any residuals impacts are considered to be non-significant.

Currently only one disposal site in the EBSA and groundfish juveniles are more widely distributed. Dredging activities in this EBSA are limited to active harbours and specific development projects. Harbour dredging does not take place every year, and the duration of such activity is short. Major projects requiring marine dredging will be reviewed by DFO Habitat for any harmful alteration, disruption or destruction of fish habitat. If habitat will be significantly disturbed, the proponent will be required to find an alternate location or create new habitat. Projects of this nature are minimal in this EBSA.

Seismic exploration, with mitigation measures in place, is generally considered unlikely to pose high risk of mortality to juvenile fish. Increased temperature due to climate change is expected to extend the northern part of the migratory range of many demersal species but likely not in next ten years.

Included – Vessel traffic was screened in for further assessment because this activity is relatively common in the Estuary and Gulf and poses a risk to vulnerable coastal nursery habitats.

Appendix B51: Features of West Coast of Newfoundland: Main migration corridor (spring-fall) for cod, redfish, and other demersal species

EBSA 10 – West coast of Newfoundland (18,238 km²; 7.1% of the EGSL)

Scoping:
There are twenty commercially important or abundant species in the Estuary and Gulf of St. Lawrence included in the demersal group of species. They may be sub-divided into large demersal (ex. Cod, redfish), small demersal (ex. rockling, sculpin) and flatfishes (ex. thorny skate, witch flounder).

Ten (10) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Habitat alteration	Noise & disturbance	Ghost nets	Temperature & salinity change	Change in ocean currents
Bottom trawl	N	N	–	–	–	–
Gillnet (bottom)	Y	–	–	Y	–	–
Longline	Y	–	–	–	–	–
Scottish/Danish seine	N	–	–	–	–	–
Purse seine	N	–	–	–	–	–
Seismic surveys	–	–	N	–	–	–
Human activity-induced climate change	–	–	–	–	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Excluded – Bottom trawling (biomass removal and habitat alteration) was screened out because with the exception of shrimp trawling it has been all but eliminated in the west coast of Newfoundland fisheries. Even if cod stocks recover, recent concern over benthic habitat alteration means that trawling is probably unlikely to be reinstated in its past form. Since the 1990s, shrimp trawls have been required to use the Nordmore Grate to limit by-catch. This management measure is expected to stay in place for the next ten years.

Danish seine, is operation along the bottom similar to trawling but because it does not use heavy rollers is not considered high risk to bottom habitat. While it does catch a number of demersal species as by-catch, use overall is limited. However, more information is needed on water depths to determine magnitude of interaction with demersal species. Purse seine is almost entirely pelagic.

Seismic exploration, with mitigation measures in place, is generally considered unlikely to pose high risk of mortality.

EBSA 10 represents middle of the range for demersal species – increased temperature due to climate is expected to extend the northern part of the migratory range but likely not in next ten years.

Included – Gillnetting (including ghost nets) and longline fishing were screened in mainly because of biomass removals.

Appendix B52: Features of West Coast of Newfoundland: Marine mammals (feeding, diversity and biomass)

EBSA 10 – west coast of Newfoundland (18,238 km²; 7.1% of the EGSL)

Scoping:
Species in this CP include: *Fish consumers* (harbour porpoises, white-sided dolphins, common dolphin, and harp, harbour and grey seals); *Opportunistic feeders* (humpback, fin, and minke whales); and *Squid consumers* (pilot whales).

Eleven (11) activities/stressors identified as potentially affecting this group were initially analyzed:

Activities/stressors	Biomass removal	Noise & disturbance	Ship strikes & collisions	Entanglement	Persistent organic pollutants & chemical contaminants
Bottom trawl	--	--	--	--	--
Gillnet (bottom)	--	--	--	Y	--
Purse seine	--	--	--	--	--
Crab pots	--	--	--	Y	--
Lobster pots	--	--	--	Y	--
Whelk pots	--	--	--	--	--
Seal hunt	N	--	--	--	--
Vessel traffic	--	Y	Y	--	--
Seismic surveys	--	Y	--	--	--
Industrial activities	--	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Excluded – Bottom trawl was screened out as it is not commonly cited as a source of entanglement. Although purse seine is the most commonly used fishing method in the EBSA, there are very few references of entanglement with this gear type in published reports.

The seal hunt was screened out because Harp seals are the only species targeted in this EBSA, and the hunt is limited to March to May.

Industrial activities were screened out because the West Coast of Newfoundland EBSA has a low population density, and very little significant industrial activity. There are very few sources of pollutants in this area.

Included – Pot gear, gillnets, vessel traffic and seismic were screened in. Crab and lobster are caught with pot gear within this EBSA, and lines between pots and buoys regularly result in entanglement. Gillnets were used from April to November, with the vast majority of landings taken in July, and marine mammals are highly prone to entanglement, although there is no systematic study in this region.

Vessel traffic was screened in for noise and ship strikes. Vessel traffic causes significant noise which affects the ability of marine mammals to feed and communicate, and can also cause ship strikes, or collisions with cetaceans during feeding, resting or sleeping at or near the sea surface. Seismic surveys have been completed in the past and are ongoing with currently 8 exploration licences in this EBSA. In recent years, there has been growing concern that the prolonged and frequent use of airguns could cause behavioural changes, loss of hearing, and masking or modifying of vocalization, all of which have been documented.

Appendix B53: Eelgrass (*Zostera marina*)

Scoping:

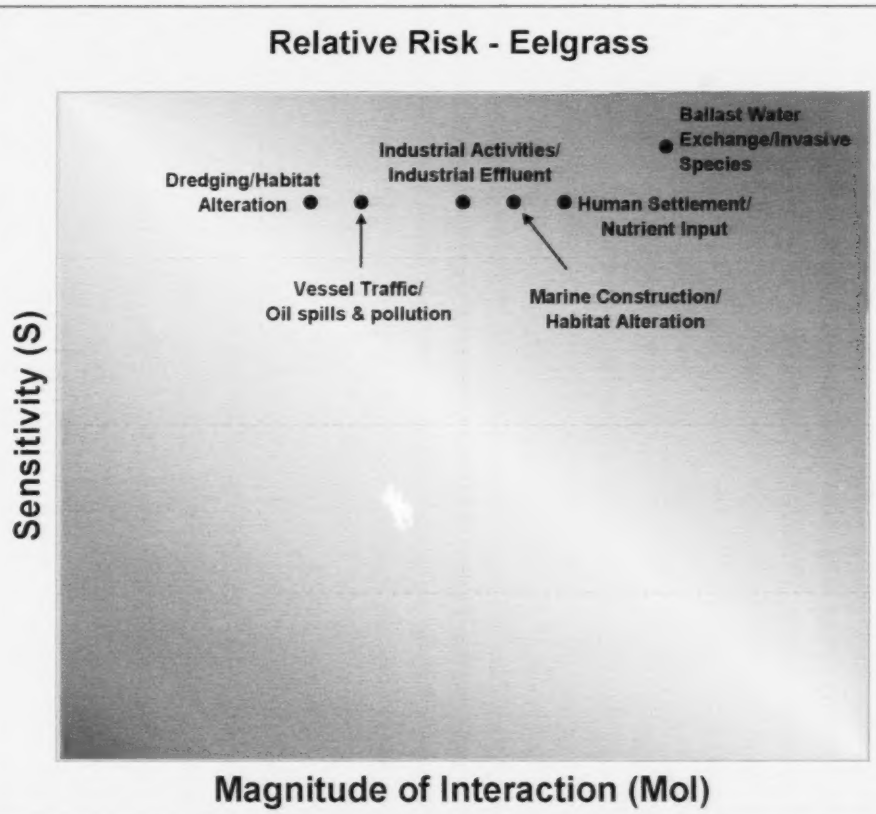
Activities/ stressors	Habitat Alteration	Nutrient Input	Change in Freshwater Input	Oil Spills and Pollution	Invasive Species	Industrial Effluents	Temperature and Salinity Change	Sea Level Rise	Increased Storm and Surges
Scallop Dredging	N	--	--	--	--	--	--	--	--
Fish Processing	--	N	--	--	--	--	--	--	--
Dredging	Y	--	--	--	--	--	--	--	--
Freshwater Diversion and Dam	--	--	N	--	--	--	--	--	--
Marine Construction	Y	--	--	--	--	--	--	--	--
Vessel Traffic	--	--	--	Y	--	--	--	--	--
Ballast Water Exchange	--	--	--	--	Y	--	--	--	--
Industrial Activities	--	--	--	--	--	N	--	--	--
Human Settlement	--	Y	--	--	--	--	--	--	--
Human Activity Induced Climate Change	--	--	--	--	--	--	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Twelve (12) activities/stressors were initially considered : Scallop Dredging / Habitat Alteration, Fish Processing / Nutrient Input, Dredging / Habitat Alteration, Freshwater Diversion and Dam / Change in Freshwater Input, Marine Construction / Habitat Alteration, Vessel Traffic / Oil Spills and Pollution, Ballast Water Exchange / Invasive Species (European green crab Carcinus maenas L.), Industrial Activities / Industrial Effluents, Human Settlement / Nutrient Input, Human Activity Induced Climate Change / Temperature and Salinity Change – Sea Level Rise – Increased Storm and Surges.

Excluded (7) – Areas of scallop (and clam) dredging are typically in deeper water than that associated with eelgrass. Fish plant processing and industrial effluent are localized and not considered an overall threat to eelgrass. While drastic changes in freshwater input could affect eelgrass, it is tolerant of minor changes and all diversion projects are subject to CEAA. It is not clear whether or not storm surges or moderate changes in water temperature or sea-level would negatively impact eelgrass beds. Warmer water temperatures may even be favorable to eelgrass.

Included (5) – Dredging and marine construction, while perhaps at low levels, occurs throughout the Estuary and Gulf of St. Lawrence. The Estuary and Gulf also has a high level of vessel traffic en route to local ports and the St. Lawrence seaway, resulting in increased risk of oil pollution and spills. Industrial activities and human settlement are extensive along the Estuary and Gulf, and communities tend to be concentrated in the same sheltered, highly productive areas as eelgrass. Consequently, eelgrass beds may be exposed to excess nutrient input due to the fact that the majority of communities are without wastewater treatment. Ballast water exchange has been linked with introduction of non-native species such as European green crab. European green crabs appear to be expanding its distribution within the Estuary and Gulf and have caused extensive damage to eelgrass beds in other areas.



Relative risk: Eelgrass has high sensitivity to perturbation due to its ecological importance and low resilience. All activities and stressors included in the vulnerability analysis have potential for direct physical contact with eelgrass when they occur together. Therefore, all have high magnitude of interaction and rank moderate or higher on the eelgrass vulnerability profile. Invasive European green crabs have the highest potential for harm followed by human settlement, marine construction, and vessel traffic and dredging.

European green crab reached the southern Gulf of St. Lawrence in the mid-1990s. Further westward expansion in the southern Gulf was confirmed along the eastern coast of Prince Edward Island in 1997 and more recently in the Northumberland Strait at the border between Nova Scotia and New Brunswick[3]. It has also now been found in coastal areas of western Newfoundland (DFO unpubl.).

Oil pollution from vessel traffic, habitat alteration from marine construction and dredging, and industrial activities, while relatively low in areal extent and intensity, have a high likelihood of direct physical contact with eelgrass when they do occur. Human settlement, one of the largest sources of marine pollution by volume and population surrounding the Estuary and Gulf, is mostly without any form of wastewater treatment.

Appendix B53: Eelgrass (*Zostera marina*) (continued)

Biology/Distribution: Eelgrass *(Zostera marina L.)* is an important primary producer and provides three dimensional structures considered important to biodiversity and productivity. Eelgrass is a common highly productive perennial aquatic plant that can form extensive inter-tidal and sub-tidal beds in estuaries and coastal areas. Its function as a habitat structure includes providing cover from predation, reducing local current regimes, and increasing secondary productivity by adding to local habitat complexity and surface area. In addition to the functional role of eelgrass in structuring habitat, it also has an important primary production role in the ecosystem which has qualified it as an Ecologically Significant Species in eastern Canada[1]. Under the trophodynamic criteria of DFO[2], eelgrass has characteristics which meet the criteria of an Ecologically Significant Species. If the species were to be perturbed severely, the ecological consequences would be substantially greater than an equal perturbation of most other species associated with this community[1].

Eelgrass occurs commonly in eastern Canada where there are suitable conditions. Eelgrass will generally be absent along rocky, high energy coastlines or areas of high turbidity. Individual meadows may be patchy if there is localized erosion and/or deposition of sediments; otherwise the beds can be continuous.

Eelgrass beds are geographically distributed throughout the St. Lawrence estuary and the Gulf of St. Lawrence in the Province of Québec. The minimum total estimated areal extent of eelgrass along the Upper, Middle and Lower North Shore, tip of the Gaspe Peninsula, Chaleur Bay and waters off Magdalen Islands is over 10,000 ha. It is estimated that there are about 20,000 ha of eelgrass in each of New Brunswick and Nova Scotia, and over 30,000 ha in Prince Edward Island. In Newfoundland and Labrador, eelgrass is distributed around the entire island with the greatest abundance on the southwest coast, which has more suitable habitat for eelgrass. There are no estimates of areal coverage, but there are several large beds on the west coast of the island[1].

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1. DFO. 2009. Does eelgrass (*Zostera marina*) meet the criteria as an ecologically significant species? Can. Sci. Advis. Sec. Sci. Advis. 2009/018. 11 p.
2. DFO. 2006. Identification of Ecologically Significant Species and Community Properties. DFO Can. Sci. Advis. Sec. Sci. Advis. 2006/041. 24 p.
3. Audet, D., Davis, D.S., Miron, G., Moriyasu, M., Benhalima, K., and Campbell L. 2003. Geographical expansion of a nonindigenous crab, *Carcinus maenas* (L.), along Nova Scotian shore into the southeastern Gulf of St. Lawrence. Can. J. Shell. Res. 22(1): 255-262.

Appendix B54: Capelin (*Mallotus villosus*)

Scoping:

Activities/ stressors	Biomass Removal	Habitat Alteration	Oil spills and pollution	Persistent Organic Pollutants	Chemical Contaminants	Industrial effluents	Temperature and Salinity Change	Increased UV Radiation
Bottom Trawl	Y	N	--	--	--	--	--	--
Scallop Dredge	Y	N	--	--	--	--	--	--
Purse Seine	Y	--	--	--	--	--	--	--
Capelin Trap	Y	--	--	--	--	--	--	--
Tuck-ring Seine	Y	--	--	--	--	--	--	--
Beach Seine	N	--	--	--	--	--	--	--
Weir	N	--	--	--	--	--	--	--
Bait Fish	N	--	--	--	--	--	--	--
Dredging		Y	--	--	--	--	--	--
Vessel Traffic	--	--	Y	--	--	--	--	--
Industrial Activities	--	--	--	--	--	Y	--	--
Human activity induced climate change	--	--	--	--	--	--	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

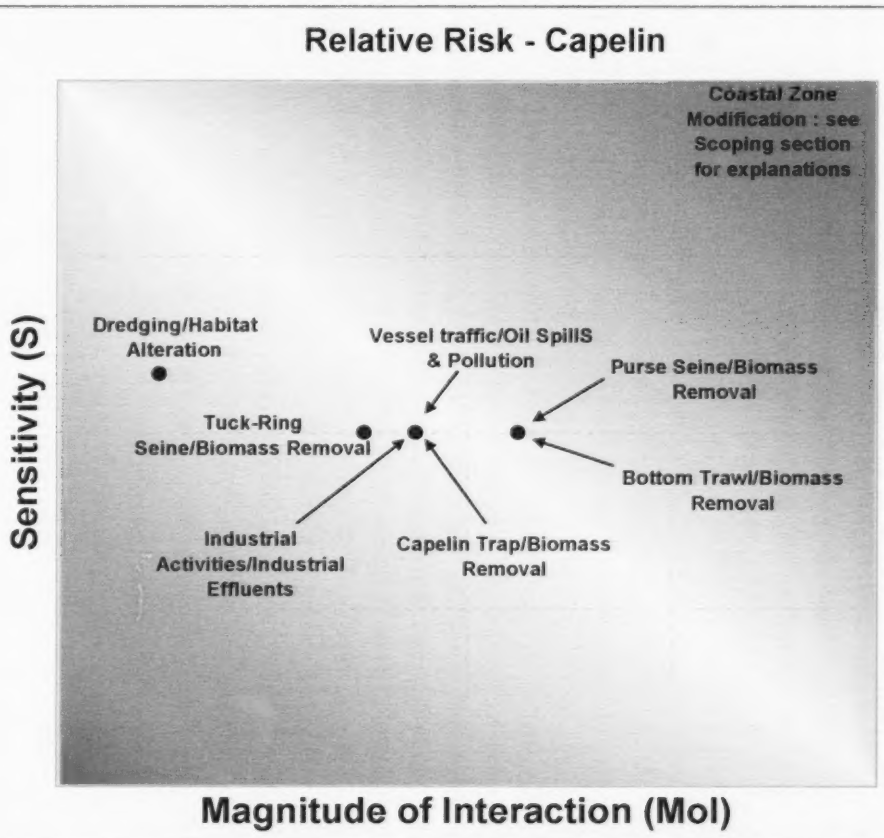
Fifteen (15) activities / stressors were considered in the capelin vulnerability analysis: Bottom Trawl / Biomass Removal – Habitat Alteration, Scallop Dredge / Habitat Alteration, Purse Seine / Biomass Removal, Capelin Trap / Biomass Removal, Tuck-ring Seine / Biomass Removal, Beach Seine / Biomass Removal, Weir / Biomass Removal, Bait Fish / Biomass Removal, Dredging / Habitat Alteration, Vessel Traffic / Oil spills and pollution, Industrial Activities / Persistent Organic Pollutants, Chemical Contaminants and Industrial effluents, Human activity induced climate change / Temperature and Salinity Change – Increased UV Radiation.

Coastal Zone Modification: Due to the lack of current data and the lack of specific focus by the task group on capelin in the analysis of the impacts of human activities on the reproductive habitat of this species, the impact of habitat modification has been identified as an issue, but not yet analyzed.

Excluded (7) – There is no probability of physical interaction between the capelin (i.e., eggs) and habitat alterations caused by bottom trawl or scallop dredging. The effects of biomass removal using beach seines and weir fishing are negligible, and null for bait fish (François Grégoire, pers. comm.).

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (8) – Capelin is a target species for the following fishing gear in the Estuary and Gulf of St. Lawrence: bottom trawl, purse seine, capelin trap and tuck-ring seine. Dredging is retained for its potential impact on the capelin's spawning habitats (beaches and shallow waters). The portion St. Lawrence Seaway Estuary and Gulf is a major maritime route, which increases the potential for oil spills and pollution. A substantial amount of industrial activity (industrial effluents) such as mining (extraction and refining) and pulp and paper occurs along the shores of the St. Lawrence River.



Relative risk profile: With its relatively high resilience, the capelin is not very sensitive to disturbances. Although this is primarily a target species for fishing with traps, purse seines and bottom trawl, the use of this gear does not appear to be problematic. However, it is essential to confirm this information with experts (fishery managers and scientists) to determine whether the cumulative effect of this gear could be harmful for capelin in the St. Lawrence.

Oil spills from vessel traffic could have considerable effects on this species if they coincide in time and space. To a lesser extent, this finding applies to industrial effluents. According to our analysis, habitat alterations caused by dredging should not cause a problem for this species at the moment. Finally, the preliminary risk analysis by the Capelin Working Group shows that modification of the shoreline (e.g., rip rap) would be a critical issue for the capelin.

Appendix B54: Capelin (*Mallotus villosus*) (continued)

Biology/Distribution: The capelin (*Mallotus villosus*) spends most of its life offshore, moving toward the coast when it is time to spawn. Its distribution is circumpolar. In the northwest Atlantic, it is found along the coast of Newfoundland and Labrador, on the Grand Banks and in the Estuary and Gulf of St. Lawrence.

The lifespan of this small pelagic fish rarely exceeds four years[1, 2]. Although it reaches sexual maturity at around two or three years, the reproductive stock is almost exclusively made up of fish aged from three to four years[3].

Eggs are generally laid at night or when skies are cloudy[3] when water temperatures range from 6 to 10 °C[4]. The spawning season usually lasts for four to six weeks. According to Grégoire et al. (2004)[5], spawning first begins in the St. Lawrence Estuary around mid-April and gradually moves east, reaching the Lower North Shore of Quebec and the west coast of Newfoundland in July.

Spawning is preceded by intensive migration toward the coast, and takes place on beaches and in shallow waters. The eggs are attached to gravel on beaches or the seabed. Incubation time varies, depending on the water temperature, with a duration of 15 days at 10 °C. The larvae move to the open sea and float near the surface until winter arrives[4]. They then move to deeper water to await the warmer waters of spring (Templeman 1948, in[3]). This species shows considerable inter-annual variability in abundance, due to its very high natural mortality rate.

Together with mackerel and herring, the capelin belongs to the pelagic group of fish that provide abundant prey for the upper trophic levels in the Estuary and Gulf of St. Lawrence. Capelin feed on small and large zooplankton[6].

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[1] Stergiou, K.I. 1991. Possible implications of climatic variability on the presence of capelin (*Mallotus villosus*) off the Norwegian coast. Climatic Change 19: 369-391.

[2] Mowbray, K. 2002. Changes in the vertical distribution of capelin (*Mallotus villosus*) off Newfoundland. J. Marine Sci. 59: 942-949.

[3] Jangaard, P.M. 1974. The capelin (*Mallotus villosus*): Biology, distribution, exploitation, utilization and composition. Bull. Fish. Res. Board Can. 186 : 1-70.

[4] MPO. 2008. Évaluation du stock de capelan de l'estuaire et du golfe du Saint-Laurent (Division 4RST) en 2007. Secr. can. de consult. sci. du MPO, Avis sci. 2008/037 : 13 p.

[5] Grégoire, F., Morneau, R., Caron, G., Beaudoin, M., Lévesque, C., Rose, C., Felix, A., and Hudon, J. 2004. Fécondité du capelan (*Mallotus villosus*) dans l'estuaire et le golfe du Saint-Laurent en 2003. Rapp. tech. can. sci. halieut. aquat. 2560: vi + 22 p.

[6] Savenkoff, C., Grégoire, F., and Chabot, D. 2004. Main prey and predators of capelin (*Mallotus villosus*) in the northern and southern Gulf of St. Lawrence during the mid-1980s and mid-1990s. Can. Tech. Rep. Fish. Aquat. Sci. 2551: vi+30 p.

Expert consulted: François Grégoire. MPO-DFO Mont-Joli – Québec.

Appendix B55: Atlantic Rock Crab (*Cancer irroratus*)

Scoping:

Activities/ stressors	Habitat Alteration	Ghost Nets	Biomass removal	Oil Spills and Pollution	Industrial Effluents	Noise and Disturbance	Temperature and Salinity Change.
Bottom Trawl	Y	–	--	--	–	–	–
Scallop Dredge	Y	–	--	--	–	–	–
Gillnets		Y	--	--	–	–	
Longlines	N	–	--	--	–	–	–
Crab Pots	Y	Y	--	--	–	–	–
Lobster Pots	Y	–	--	--	–	–	–
Dredging	Y	–	--	--	–	–	–
Vessel Traffic	--	–	--	Y	–	–	–
Industrial Activities	--	–	--	--	Y	–	–
Seismic Surveys	–	–	--	--	–	N	–
Human Activity induced Climate Change	–	–	–	--	–	–	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

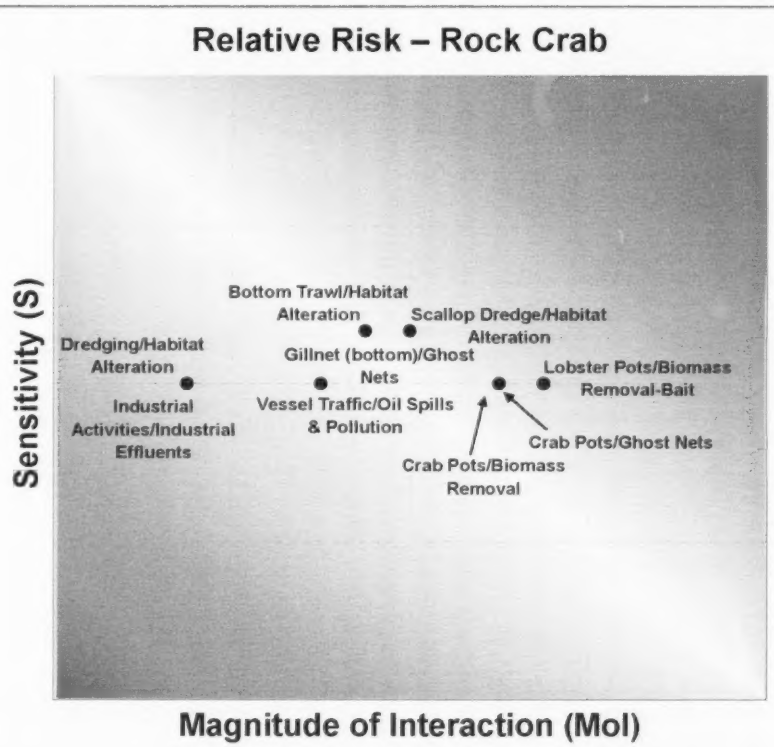
Twelve (12) activities / stressors were initially considered in the analysis: Bottom Trawl / Habitat Alteration, Scallop Dredge / Habitat Alteration, Gillnets / Ghost Nets, Longline / Habitat Alteration, Crab Pots / Biomass removal – Ghost Nets, Lobster Pots / Biomass Removal (Unreported Bait Fishing and incidental catch), Dredging / Habitat Alteration, Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluents, Seismic Surveys / Noise and Disturbance, Human Activity induced Climate Change / Temperature and Salinity Change.

Excluded (3) – The probability of spatial overlap between the distribution of rock crab and longlines is negligible. Given the low probability that seismic surveys will commence in the Estuary and Gulf of St. Lawrence within the next ten years and the uncertain impacts on this ecosystem, this activity was not retained.

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (9) – Mobile gear such as bottom trawl and scallop dredges are known to cause damage to benthic communities. The rock crab is a target species for trap fishing in the Estuary and Gulf of St. Lawrence. It is also caught during lobster fishing as bait fish and incidental catch.

The issues regarding gillnets and ghost traps are problematic, despite the uncertainty with respect to their number. The St. Lawrence Seaway is a major maritime route, which increases the potential for oil spills and pollution. A substantial amount of industrial activity (industrial effluents) such as mining (extraction and refining) and pulp and paper occurs along the shores of the St. Lawrence River.



Relative risk profile: According to the determined profile, rock crab are not very sensitive to disturbances due to their relatively high resilience. On the other hand, habitat changes caused by bottom trawling and dredging as well as oil spills from vessel traffic can wield a considerable impact on this species if they coincide in time and space.

Trap fishing (crab and lobster) has had the greatest impact on the rock crab so far. Bait fishing and incidental catches in lobster traps seems to have a slightly stronger impact than rock crab fishing. Nevertheless, fishing activities do not appear to be problematic at this point. Ghost fishing with traps and gillnets have been identified as an issue, but there are no data with which to assess the real impact of this issue on rock crab populations. Finally, according to our analysis, industrial effluents and dredging should not wield a major impact on this species.

Appendix B55: Atlantic Rock Crab (*Cancer irroratus*) (continued)

Biology/Distribution: The rock crab (*Cancer irroratus*) is distributed along the Atlantic coast from South Carolina to Labrador, from the intertidal zone to a depth of 575 m[1]. Although this species is associated with various types of substrate, it concentrates in shallow waters and seems to prefer a sandy bottom[1]. It is found in large numbers in Chaleur Bay and the Northumberland Strait. It is also found in the Shediac Valley, along the north shore of Prince Edward Island and around the Magdalen Islands. Its distribution is not well known in the Estuary and the northern Gulf of the St. Lawrence because the reports do not cover depths of less than 50 m[2].

Rock crabs grow through a series of molts, during which they sheds their hard outer shell. Molting frequency slows once the crab becomes sexually mature. On average, the width of the carapace of a mature female is 57 mm and 75 mm for a mature male. Rock crab is a dimorphic species. Males can be as large as 140 mm wide, whereas females rarely exceed 100 mm. Mating occurs in the fall, after the female has molted and her shell is still soft. Males molt in winter so their shell is completely hard during mating season. The carapace takes from two to three months to fully harden. The females extrude the eggs and carry them under their abdomen for about 10 months. A female 60 mm in width can lay 125,000 eggs, and a female 90 mm in width can lay up to 500,000 eggs. The pelagic larvae go through six stages before settling to the bottom of the water by mid-September. Juveniles (less than 15 mm) concentrate mainly in shallow depths on substrates or sheltered grounds that provide protection from predators and turbulent waters. Male rock crabs take about 6 years to reach commercial size and remain in the fishery for 1-2 years[3].

Rock crabs are omnivorous and their diet reflects some opportunism. Lobsters are one of their predators, as analysis of lobster stomach contents reveals that rock crab is an important prey at any given stage of the lobster's life, even during the early larva stage[3].

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[1] MPO. 2008. Évaluation de la pêche du crabe commun (*Cancer irroratus*) dans les zones de pêche du homard (ZPH) 23, 24, 25, 26A et 26B, dans le sud du golfe du Saint-Laurent, de 2000 à 2006. Secr. can. consult. Sci. du MPO, Avis sci. 2008/022: 9 p.

[2] Chabot, D., Rondeau, A., Sainte-Marie, B., Savard, L., Surette, T., and Archambault, P. 2007. Distribution des invertébrés benthiques dans l'estuaire et le golfe du Saint-Laurent, Secr. can. consult. Sci. du MPO, Avis sci. 2007/018 : vii + 108 p.

[3] MPO. 2010. Le crabe commun des eaux côtières du Québec en 2009. Secrétariat canadien de consultation scientifique, Région de Québec. Secr. can. consult. Sci. du MPO, Avis sci. 2010/010 : 14 p.

Expert consulted: Michel Comeau. MPO-DFO Mont-Joli – Québec.

Appendix B556: Snow Crab (*Chionoecetes opilio*)

Scoping:

Activities/ stressors	Habitat Alteration	Biomass Removal	Ghost Nets	Oil Spills and Pollution	Industrial Effluents	Noise and Disturbance	Temperature and Salinity Change
Bottom Trawl	Y	N	--	--	--	--	--
Scallop Dredge	N	--	--	--	--	--	--
Gillnets	--	--	Y	--	--	--	--
Longline	N	--	--	--	--	--	--
Crab Pots	--	Y	Y	--	--	--	--
Dredging	N	--	--	--	--	--	--
Vessel Traffic	--	--	--	Y	--	--	--
Industrial Activities	--	--	--	--	Y	--	--
Seismic Surveys	--	--	--	--	--	N	--
Human Activity Induced Climatic Change	--	--	--	--	--	--	N

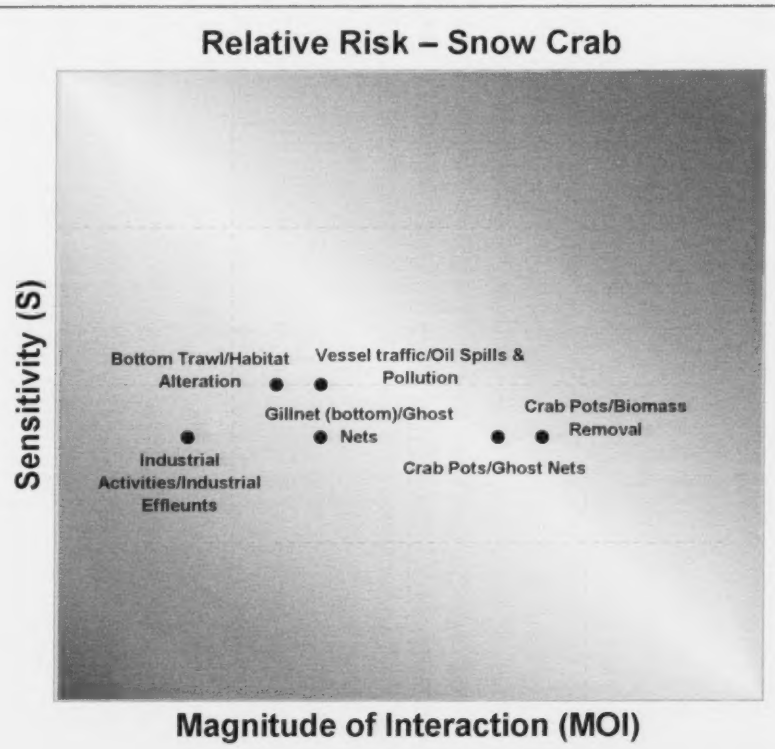
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Twelve (12) activities / stressors were considered in the snow crab vulnerability analysis: Bottom Trawl / Habitat Alteration – Biomass Removal, Scallop Dredge / Habitat Alteration, Gillnets / Ghost Nets, Longline / Habitat Alteration, Crab Pots / Biomass Removal – Ghost Nets, Dredging / Habitat Alteration, Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluents, Seismic Surveys / Noise and Disturbance, Human Activity Induced Climatic Change / Temperature and Salinity Change.

Excluded (6) – Mortality due to accidental capture by bottom trawling is negligible, as survival rates during live release are high, according to Luc Savoie (DFO, pers. comm.). The probability of spatial overlap between snow crab distributions and scallop dredging or dredging is negligible. According to Bernard Sainte-Marie (DFO, pers. comm.), longlines should have very little impact on the benthic habitat of this invertebrate. Given the low probability that seismic surveys will commence in the Estuary and Gulf of St. Lawrence within the next ten years and the uncertain impacts on this ecosystem, this activity was not retained.

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (6) – Although the use of bottom trawls has diminished in recent years, the habitats of benthic communities have been considerably altered by this mobile gear. The snow crab is a target species for trap fishing in the Estuary and Gulf of St. Lawrence. Gillnets and ghost traps are problematic issues, despite the uncertainty as to their numbers. The St. Lawrence Seaway is a major maritime route, which increases the potential for oil spills and pollution. A substantial amount of industrial activity (industrial effluents) such as mining (extraction and refining) and pulp and paper occurs along the shores of the St. Lawrence River.



Relative risk profile: According to the determined profile, snow crab is not very sensitive to disturbances in view of its relatively high resilience. On the other hand, habitat changes caused by bottom trawling and oil spills from vessel traffic can wield a considerable impact on this species if they coincide in time and space.

Trap fishing has had the greatest impact on snow crab so far, although it does not appear to be problematic at this point. Ghost fishing with traps and gillnets has been identified as an issue, but there are no data with which to assess the real impact on snow crab populations. Finally, according to our analysis, industrial effluents should not cause a major impact on this species.

Appendix B56: Snow Crab (*Chionoecetes opilio*) (continued)

Biology/Distribution: The snow crab (*Chionoecetes opilio*) is a crustacean that, unlike the lobster, does not molt continuously throughout its life span. Males and females cease to molt after they reach functional maturity. Functional maturity occurs when the gonads are mature and the chela of male crabs becomes enlarged and the female abdomen has enlarged to carry its eggs. Females carry their eggs for about two years before they hatch from late spring to early summer. The newly hatched larvae spend from 12 to 15 weeks throughout the water column before settling on the sea bottom[1].

Environmental factors such as temperature can influence molting, the reproductive cycle and migration in this species. Bottom temperatures in most of the Estuary and Gulf of St. Lawrence are typically below 3°C, which is considered to be a suitable temperature for snow crabs[2].

From analyses of the stomach contents of cod, which are predators of the snow crab, the main snow crab nurseries are found off the coast of Newfoundland, on American Bank, in the Shediac Valley and in the Cape Breton Corridor[3]. Studies by Briand[4] indicate that the nurseries are established in water depths of from 65 to 165 m in the northern Gulf and from 40 to 80 m and from 130 to 170 m in the southern Gulf, with temperatures ranging from -0.5 to 3°C[3]. The adults occupy the infralittoral, circalittoral and bathyal zones (respectively 0–20, 20–200 and 200–500 m) in the Estuary and Gulf of St. Lawrence[3]. The snow crab frequents mud and gravel substrates[5, 6].

Snow crab feeds on a large number of benthic and suprabenthic organisms, including phytobenthos, foraminifers, shrimp, crabs (intra- and inter-specific), amphipods, copepods, isopods, cumacea, ostracods, bivalves, ophiuroids, polychaetes, gastropods, chitons, medusas and fish[6]. Immature snow crabs are eaten by the Atlantic cod and the thorny skate[7].

Snow crab are particularly abundant in the Shediac Valley and on American Bank, Orphelin Bank and Bradelle Bank[3]. Incidental capture of this species by mobile gear, as reported in the multidisciplinary survey of the northern Gulf and the Sentinel surveys, show that snow crab (almost exclusively large adult males) also venture into the channels[3,8].

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[1] MPO. 2010. Évaluation du crabe des neiges du sud du golfe du Saint-Laurent (zones 12, 19, 12E et 12F). Secr. can. consult. Sci. du MPO, Avis sci. 2010/015 : 22 p.

[2] MPO. 2009. Évaluation du crabe des neiges du sud du golfe du Saint-Laurent (zones 12, 19, E et F). Secr. can. consult. Sci. du MPO, Avis sci. 2009/006 : 20 p.

[3] Chabot, D., Rondeau, A., Sainte-Marie, B., Savard, L., Surette, T., and Archambault, P. 2007. Distribution des invertébrés benthiques dans l'estuaire et le golfe du Saint-Laurent. Secr. can. consult. Sci. du MPO, Doc. Rech. 2007/018 : vii + 108 p.

[4] Briand, K. 2004. Distribution et force de recrutement des juvéniles du crabe des neiges (*Chionoecetes opilio*), vues à travers les contenus stomacaux de morue franche (*Gadus morhua*). Mémoire de maîtrise. ISMER, Université du Québec à Rimouski, Rimouski (Québec).

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Expert consulted: Bernard Sainte-Marie. MPO-DFO Mont-Joli – Québec.

Appendix B567: Northern Shrimp (*Pandalus borealis*)

Scoping:

Activities/ stressors	Biomass Removal	Oil Spills and Pollution	Industrial Effluents	Temperature and Salinity Change	Toxic Algal Bloom
Bottom Trawl	Y	--	--	--	--
Vessel Traffic	--	Y	--	--	--
Industrial Activities	--	--	N	--	--
Human Activity induced Climate Change	--	--	--	N	--
Others	--	--	--	--	N

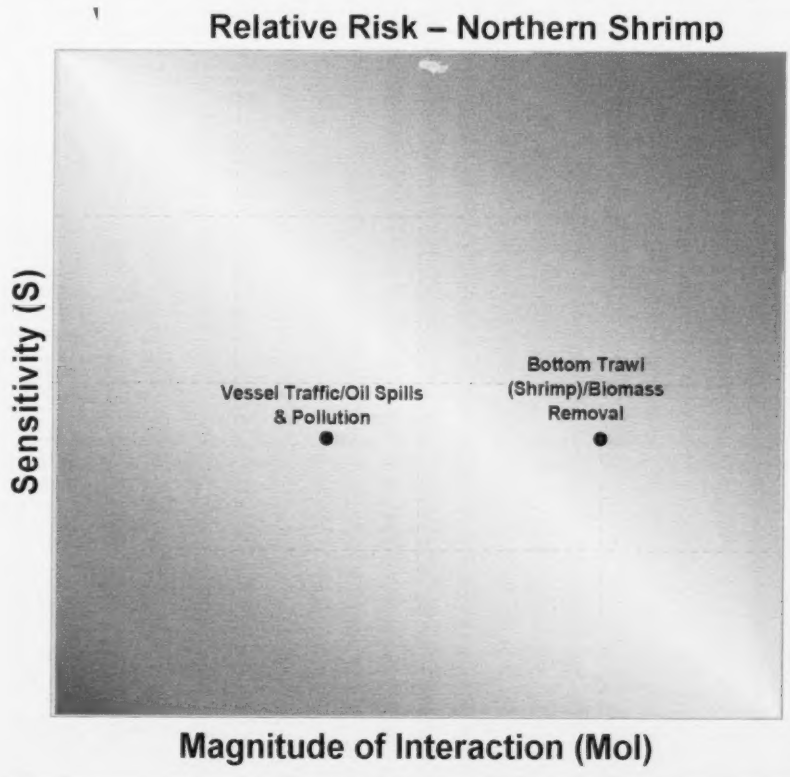
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Five (5) activities / stressors were considered in the Northern shrimp vulnerability analysis: Bottom Trawl (Shrimp) / Biomass Removal, Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluents, Human Activity induced Climate Change / Temperature and Salinity Change, Others / Toxic Algal Bloom.

Excluded (3) – The probability of spatial overlap between the distribution of industrial effluents caused by industrial activities and the distribution of northern shrimp is negligible. In Quebec, blooms of *A. tamarense* recur annually. Due to their natural presence and the inter-annual variability of the impact on marine ecosystems, this impact was not retained for analysis.

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (2) – The northern shrimp is a target species for bottom trawl (for shrimp) in the Estuary and Gulf of St. Lawrence. The St. Lawrence Seaway is a major maritime route, which increases the potential for oil spills and pollution.


Relative Risk – Northern Shrimp
Sensitivity (S)
Vessel Traffic/Oil Spills & Pollution
Bottom Trawl (Shrimp)/Biomass Removal
Magnitude of Interaction (MoI)

Relative risk profile: According to the determined profile, the northern shrimp, due to its relatively high resilience and the few activities/stressors identified or retained for analysis, is not very sensitive to disturbances. However, oil spills from vessel traffic could have harmful effects on this species if they coincide in time and space.

Bottom trawl (shrimp trawl) has had the greatest impact on the northern shrimp so far, although it does not appear to be problematic at this point.

Appendix B57: Northern Shrimp (*Pandalus borealis*) (continued)

Biology/Distribution: The northern shrimp (*Pandalus borealis*) is a cold-water decapod that changes its sex over its lifetime (i.e., a protandric hermaphrodite). They first mature as males around age 2½ and then change sex to spend from four to five years as females. Therefore, females are larger than the younger males[1, 2]. The preferred temperature of this species is from about 1 to 6 °C[3].

Shrimp demonstrate highly migratory behaviour linked to spawning that is well known by commercial fishermen. Breeding occurs in the fall. Females carry their eggs for about eight months, from September to April, and then migrate to shallower waters within their distribution area. In the spring they gather at sites where they can release the larvae, while the males are more scattered. Once the larvae are hatched, the females molt and then head for deeper waters[1, 2, and 4].

The significant reduction in abundance of demersal species and the resultant drop in predation in the mid-1990s could explain why stocks of northern shrimp increased by the late 1990s [5]. Greenland halibut gradually replaced the Atlantic cod and the redfish as the main predators of shrimp[5]. Shrimp feed in both benthic and pelagic environments during their daily vertical migrations. Bundy *et al.*[5] estimate that 30% of their feeding is benthic and 70% pelagic. Annelids, small crustaceans, phytoplankton and detritus make up the main prey during the day (benthic), while copepods and euphasids are eaten at night (pelagic).

The northern shrimp is particularly abundant in the northwestern Gulf of St. Lawrence, including the Honguedo Strait, parts of American Bank and Orphelin Bank, and in the Anticosti Channel and the Esquiman Channel. There are far fewer west of the Estuary and Gulf. In the northwestern Atlantic they are found from Greenland to New England. They also inhabit the eastern Atlantic, the Bering Sea and the Pacific Ocean[3, 6].

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[2] Savard, L., Bouchard, H., and Bourdages, H. 2002. Évaluation des stocks de crevettes (*Pandalus borealis*) de l'estuaire et du golfe du Saint-Laurent pour la période 1990-2001. Secr. can. Consult. sci. du MPO, Doc. Rech. 2002/068: 88 p.

[3] Koeller, P.A. 2000. Relative importance of abiotic and biotic factors to the management of the northern shrimp (*Pandalus borealis*) fishery on the Scotian Shelf. J. Northw. Atl. Fish. Sci. 27: 21-33.

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Appendix B578: Greenland Halibut (*Reinhardtius hippoglossoides*)

Scoping:

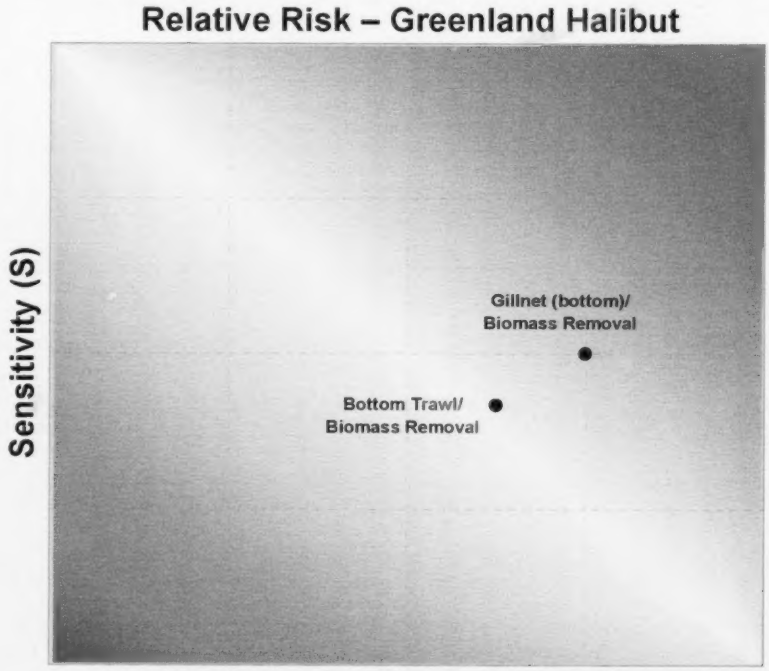
Activities/ stressors	Biomass Removal	Habitat Alteration	Ghost Nets	Noise and Disturbance	Oil Spills and Pollution	Industrial Effluent
Bottom Trawls	Y	N	--	--	--	--
Scallop Dredge	N	N	--	--	--	--
Gillnets	Y	N	N	--	--	--
Danish and Scottish Seines	N	N	--	--	--	--
Longlines	N	N	--	--	--	--
Handlines	N	--	--	--	--	--
Pair Trawl	N	N	--	--	--	--
Midwater Trawl	N	--	--	--	--	--
Shrimp Trawl	N	--	--	--	--	--
Seismic Surveys	--	--	--	N	--	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Seventeen (17) activities/stressors were initially considered for inclusion in the vulnerability index for Greenland halibut. Potential impacts on Greenland halibut distribution in the GSL include Bottom (otter) Trawls / Biomass Removal – Habitat Alteration, Scallop Dredge / Biomass Removal – Habitat alteration, Gillnets (bottom) / Biomass removal – Habitat Alteration – Ghost Nets, Danish and Scottish Seines / Biomass Removal – Habitat Alteration, Longlines / Biomass Removal – Habitat Alteration, Handlines / Biomass Removal, Pair Trawl / Biomass Removal – Habitat Alteration, Midwater Trawl / Biomass Removal, Shrimp Trawl / Biomass Removal, Seismic Surveys / Noise and Disturbance. A variety of human activities / stressors were considered (e.g. Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluent, Dredging / Habitat Alteration and Human Activity-Induced Climate Change), however only those deemed to have the potential for significant effects on the species were included in the scope of the analysis.

Excluded (15) – Landings by seines and longlines are insignificant, while handlines, pair trawls and mid-water trawls are not used in this fishery. Scallop dragging occurs in shallow areas outside of the species' distribution. Since the shrimp fishery began using Nordmore Grates, the by-catch of groundfish has basically been eliminated. Given that disruptions to the ocean floor would only provide very short-term impacts (i.e., food sources may be disturbed within the reaches of the trawl), it is not believed that habitat alteration by longlines, pair trawls and seines will provide a significant impact on this species. Ghost nets represent a reduced level of threat compared to active gears, are less numerous and as time passes become less efficient at fishing. Oil spills in the Estuary and Gulf are rare events. There is no conclusive evidence supporting the concern that noise and pressure changes associated with seismic surveys impact finfish[3,4].

Included (2) – Bottom gillnets accounted for 95% of landings during the period from 2000-2007. Although bottom trawls capture only 2% of the landings in the Estuary and Gulf, a sizeable amount of the landings in the southern Gulf are captured using bottom trawl and thus warrants further consideration.



Relative risk profile: In the GSL, there is a 25-75% overlap of the species distribution with the distribution of bottom gillnets and a 5-25% overlap with bottom trawls. These gear types are designed to capture demersal species, thus full contact is expected when the gears coincide with the species. The Greenland halibut population of the GSL is considered to be a stock isolated from the main Northwest Atlantic population that complete their entire life cycle within the Estuary and Gulf. Taking into account the use of bottom trawls and bottom gillnets in this and other fisheries, duration is almost certain to coincide significantly with the species (>95%). According to the logbook data, the intensity of bottom gillnets relative to the species distribution is considered to be moderate (25-75%), while the intensity of bottom trawl is considered to be unlikely (5-25%).

Given the reduced size at 50% maturity, the recent drop in biomass, the amount of landings by these gears, and the impacts of bottom trawls and bottom gillnets on the seafloor, the acute and chronic impacts of bottom trawls and bottom gillnets on this species and its habitat are estimated to be low and medium, respectively. Greenland halibut function as both predator and prey in the ecosystem. The loss or significant decline of the species is expected to cause a medium disruption to the ecosystem function. Greenland halibut recruitment is sensitive to environmental conditions. Considering the state of the stock, the sensitivity of the stock is expected to be medium.

Appendix B58: Greenland Halibut (*Reinhardtius hippoglossoides*) (continued)

Biology/Distribution: The Estuary and Gulf of St. Lawrence population of Greenland halibut, being separated from the main Northwest Atlantic population, completes its entire life cycle within the Estuary and Gulf. In the northern GSL, the main concentrations are observed north, south and west of Anticosti Island and in the Esquiman Channel. There were significant decreases in male size at maturity between 1996 and 2001. Since this time, size at maturity has generally remained below the series average (1996-2008). Spawning predominantly occurs from January to March. Juveniles dominate the estuary and north of Anticosti, however abundance varies extensively from year to year with recruitment to the fishery occurring at age 5. Year-class strength, growth, and environmental conditions have an effect on fluctuations in stock abundance and therefore the success of the fishery[1]. Greenland halibut are voracious bathypelagic predators, feeding on capelin, Atlantic cod, polar cod, young Greenland halibut, roundnose grenadier, barracudinas, redfishes, sand lance, crustaceans, especially *Pandalus borealis*, cephalopods (squid) and small amounts of various benthic invertebrates. Predators include the Greenland shark, white whales, narwhals, and hooded seals. Among the fishes, cod, salmon, and even Greenland halibut consume the young[2].

Abundance indicators were generally below the 1990-2008 average in the early 1990s, with total biomass values being the lowest in the 1990-2008 series. The distribution of the stock was restricted to the Estuary and the head of the Gulf channels. There was an increase in productivity resulting in an improvement in biomass and abundance indicators during the late 1990s and early 2000s due to a recruitment of year-classes of higher abundance. In subsequent years, the production of juveniles alternated between high and moderate to low abundance, with the strongest cohorts observed in the 1997 and 1999 year-classes. Improved recruitment led to a considerable increase in the biomass indices, which was followed by a period of stable recruitment. Therefore, preceding the recent decline, the values of the biomass index were near the 1999-2008 average[1].

Leading up to the mid-1970s, landings of Greenland halibut in 4RST were mostly composed of by-catches from other fisheries. Following this period, a directed gillnet fishery arose causing substantial fluctuations in landings. Landings increased to 3,900 t from 2001 to 2004. Since that period, landings have been relatively stable. In 2009, preliminary landings for NAFO Divisions 4RST totaled 4,002 t[1].

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[1] DFO. 2010. Assessment of the Greenland Halibut Stock in the Gulf of St. Lawrence (4RST) in 2009. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/028. 14 p.

[2] Scott, W.B., and Scott, M.G. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.

[3] DFO. 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Rep. 2004/002. 15 p.

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Appendix B589: Atlantic Herring (*Clupea harengus*)

Scoping:

Activities/ stressors	Biomass Removal	Biomass Removal 4S	Biomass Removal 4R	Biomass Removal 4T	Habitat Alteration	Ghost Nets	Oil Spills and Pollution	Industrial Effluents	Noise and Disturbance	Temperature and Salinity Change
Bottom Trawl	--	--	--	--	N	--	--	--	--	--
Scallop Dredge	N	--	--	--	N	--	--	--	--	--
Gillnets	--	Y	N	Y		N	--	--	--	--
Midwater Trawl	--	N	--	--	--	--	--	--	--	--
Purse Seine	--	N	Y	Y	N	--	--	--	--	--
Trap	--	Y	N	N	--	--	--	--	--	--
Tuck-Ring Seine	--	--	Y	--	--	--	--	--	--	--
Dredging	--	--	--	--	Y	--	--	--	--	--
Vessel Traffic	--	--	--	--	--	--	N	--	--	--
Industrial Activities	--	--	--	--	--	--	--	Y	--	--
Seismic Surveys	--	--	--	--	--	--	--	--	N	--
Human Activity induced Climatic Change	--	--	--	--	--	--	--	--	--	N

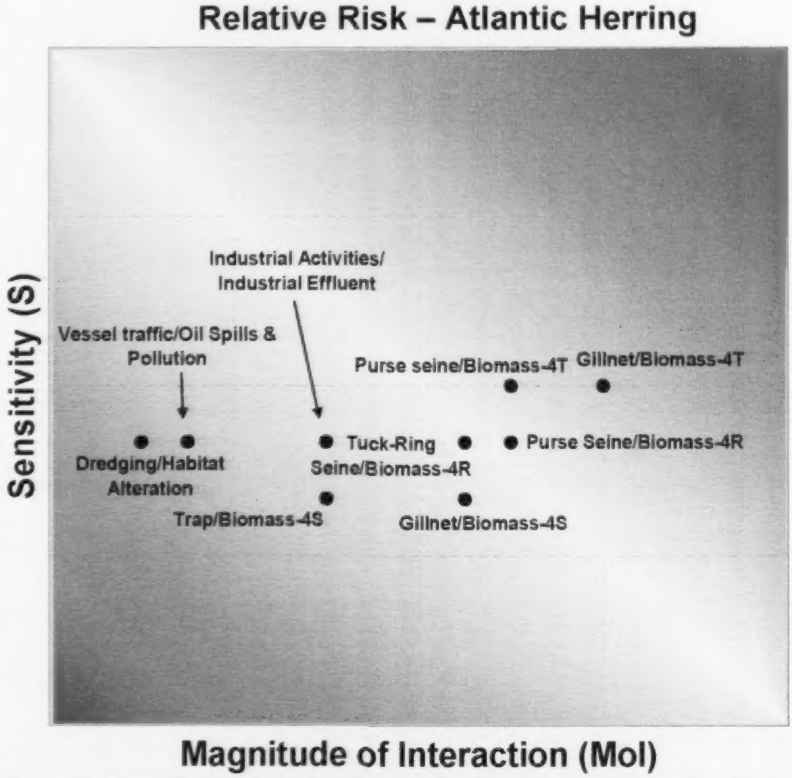
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Following the suggestion by François Grégoire (Fisheries and Oceans Canada), the analysis of fishing gear used has been divided according to the 4S, 4T and 4R stocks. Twenty-one (21) activities / stressors were considered in the herring vulnerability analysis: Midwater Trawl / Biomass Removal, Bottom Trawl / Biomass Removal– Habitat Alteration, Scallop Dredge / Biomass Removal – Habitat alteration, Gillnets / Biomass Removal 4S, 4T, and 4R – Ghost Nets, Purse Seine / Biomass Removal 4S, 4T, and 4R – Habitat Alteration, Trap / Biomass Removal 4S, 4R and 4T, Tuck-Ring Seine / Biomass Removal 4R, Dredging / Habitat Alteration, Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluents, Seismic Surveys / Noise and Disturbance, Human Activity induced Climatic Change / Temperature and Salinity Change.

Excluded (13) – Midwater trawl is rarely used in Division 4S. Biomass removal by bottom trawl has a negligible impact on herring populations in the Estuary and Gulf of St. Lawrence. There is no official by-catch limit for scallop dredging pelagic species. The probability of physical interaction with bottom trawling is negligible, and null for scallop dredging. According to François Grégoire (Fisheries and Oceans Canada, pers. comm.), the impact of ghost fishing on this species is negligible. Purse seine fishing no longer occurs in Division 4S, and the impacts of trapping on Division 4R are negligible due to low landings. Given the uncertainty regarding the impacts of seismic surveys and the low probability of seismic surveys occurring in the Estuary and Gulf of St. Lawrence within the next ten years, this activity was not retained.

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (8) – The herring is a target species for the following fishing gear in the St. Lawrence River: gillnet (4S and 4T), purse seine (4R and 4T), trap (4S), and tuck-ring seine (4R). Dredging is retained for its potential impacts on herring spawning habitats. The St. Lawrence Seaway is a major maritime route, which increases the potential for oil spills and pollution. A substantial amount of industrial activity (industrial effluents) such as mining (extraction and refining) and pulp and paper occurs along the shores of the St. Lawrence River.



Relative risk profile: According to the determined profile, the situation of herring is considered precarious in NAFO Division 4T, under control in Division 4R, and not problematic in Division 4S.

If it coincides in time and space, pollution by industrial effluents could have considerable effects on this species. To a lesser extent, this finding applies to oil spills from vessel traffic. According to our analysis, habitat changes due to dredging should not cause a problem in this area.

Appendix B59: Atlantic Herring (*Clupea harengus*) (continued)

Biology/Distribution: The Atlantic herring (*Clupea harengus*) is a deep-sea species found on both sides of the North Atlantic Ocean and in the Baltic Sea. In the northwest, it is distributed from Cape Hatteras to the northern tip of Labrador[1]. Herring make lengthy annual migrations to areas for spawning, feeding and breeding[2, 3]. It also moves great distances vertically, generally keeping to deep water during the day, at depths as much as 200 metres[4], and rising to the surface at night[1].

It reproduces in specific spawning grounds in coastal waters and on offshore banks[1]. Most individuals spawn for the first time at the age of four[3]. Herring is the only member of the family Clupeidae that has eggs that are attached to the bottom. Depending on its size, a female can lay from 20,000 to 100,000 eggs.

Herring is an important component of the ecosystem due to its abundance and its role as a forage species. It transfers energy to higher levels of the food web by serving as prey for many fish species (cod, tuna), birds and marine mammals (whales, grey seal, harp seal). In addition, the eggs deposited on the seabed feed many benthic species, including winter flounder. In addition to serving as prey, herring also play a role as a predator of the eggs and larvae of several species of fish[1], zooplankton and benthic invertebrates[5].

Since the decline of the demersal fish stocks, herring, like several other ocean species, has become more important in the ecosystem dynamics of the Estuary and Gulf of St. Lawrence, and it currently plays a predominant role[6]. For example, the herring is an important component of the fish community in the southern Gulf[3].

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[1] CCRH. 2009. L'avenir de la pêche : le hareng dans l'est du Canada. Conseil pour la conservation des ressources halieutiques. 46 p.

[2] MPO. 2010. Évaluation des stocks de hareng de la côte ouest de Terre-Neuve (division 4R) en 2009. Secr. can. de consult. sci. du MPO, Avis sci. 2010/032 : 11 p.

[3] MPO. 2010. Évaluation du hareng du sud du golfe Saint-Laurent (Div. 4T de l'OPANO). Secr. can. de consult. sci. du MPO, Avis sci. 2010/023 : 20 p.

[4] Scott, W.B., and Scott, M.G. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.

[5] MPO. 2006. Assessment of the West Coast of Newfoundland (Divicion 4R) herring stocks in 2005. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2006/021: 12 p.

[6] Morissette, L., Castonguay, M., Savenkoff, C., Swain, D.P., Chabot, D., Bourdages, H., Hammill, M.O., and Hanson, J.M. 2009. Contrasting changes between the northern and southern Gulf of St. Lawrence ecosystems associated with the collapse of groundfish stocks. Deep Sea Res. II 56: 2117-2131.

Expert consulted : François Grégoire. MPO-DFO Mont-Joli – Québec.

Appendix B59: Krill (2 species) (*Euphausia* spp.)

Scoping:

Activities/ stressors	Biomass Removal	Oil spills and pollution	Industrial Effluents	Temperature and Salinity Change	Toxic Algal Blooms
Midwater Trawl	N	--	--	--	--
Vessel Traffic	--	Y	--	--	--
Industrial Activities	--	--	N	--	--
Human Activity-Induced Climate Change	--	--	--	N	--
Others	--	--	--	--	N

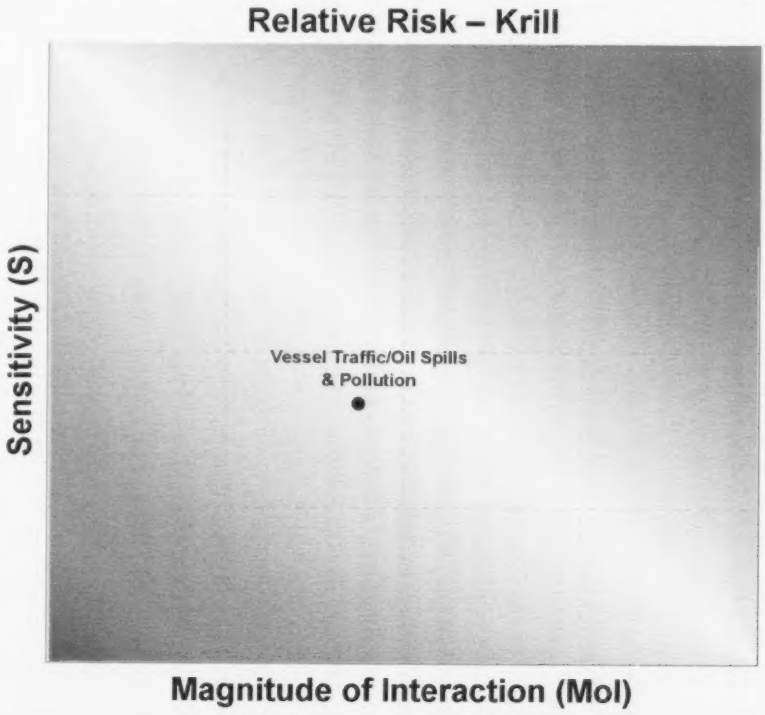
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Five (5) activities / stressors were considered in the krill vulnerability analysis: Midwater Trawl / Biomass Removal, Vessel Traffic / Oil spills and pollution, Industrial Activities / Industrial Effluents, Others / Toxic Algal Blooms, Human Activity-Induced Climate Change / Temperature and Salinity Change.

Excluded (4) – At this point there is no krill fishing in the Canadian Atlantic, although the industry has wanted to develop a zooplankton fishery in the Estuary and Gulf of St. Lawrence since 1985 (moratorium since 1998). The probability of spatial overlap between industrial effluents and krill distributions is negligible. In Quebec, blooms of *A. tamarense* recur annually. Due to their natural presence and the inter-annual variability of the impact on marine ecosystems, this impact was not retained for analysis.

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (1) – The St. Lawrence Seaway is a major maritime route, which increases the potential for oil spills and pollution.



Relative risk profile: According to the determined profile, the krill is not sensitive to disturbances, given its relatively high resilience and the few combinations of activities/stressors identified and retained for this species. On the other hand, oil spills from vessel traffic could have considerable effects on this species if they coincide in time and space.

Appendix B60: Krill (2 species) (*Euphausia* spp.) (continued)

Biology/Distribution: Krill (euphausiid spp.), a small crustacean, is found in large concentrations at the head of the Laurentian Channel in the Gulf of St. Lawrence. This area is known as the site with the greatest aggregation of krill in the northwest Atlantic[1].

Although the depth varies depending on the area, the vast majority of krill in the Estuary live in deeper water during the daytime, at depths from 100 to 120 m (Ian McQuinn, DFO, comm. pers.) and migrate to the surface at night to feed (0-50 m)[2]. During the reproductive period, in the spring and fall, the adults migrate to the surface to lay their eggs, and the eggs and larvae remain on the surface (Ian McQuinn, DFO, comm. pers.).

In the Estuary and Gulf of St. Lawrence, krill is a key species for the marine food web[3]. The distribution of krill aggregations makes this an important feeding area for marine mammals such as minke whales, fin whales, humpback whales and blue whales. The blue whale, an endangered species, feeds mainly on krill[4]. Krill is also the primary food source for juveniles and adults of many fish species such as capelin, redfish, cod, herring and mackerel. Krill is known as an important predator of copepod as well as other zooplankton.

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1. Simard, Y., and Lavoie, D. 1999. The rich krill aggregation of the Saguenay–St. Lawrence Marine Park: hydroacoustic and geostatistical biomass estimates, structure, variability, and significance for whales. Can. J. Fish. Aquat. Sci. *56*: 1182-1197.

2. Harvey, M., Galbraith, P. S., and Descroix, A. 2009. Vertical distribution and diel migration of macrozooplankton in the St. Lawrence marine system (Canada) in relation with the cold intermediate layer thermal properties. Prog. Oceanogr. 80: 1-21.

3. Sourisseau, M., Simard, Y., and Saucier, F. J. 2004. Aggregation and advection of macro-zooplancton in the St. Lawrence System. International Council for the Exploration of the Sea. 24 p.

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Expert consulted: Ian McQuinn. MPO-DFO Mont-Joli – Québec.

Appendix B601: Atlantic Mackerel (*Scomber scombrus*)

Scoping:

Activities/ stressors	Biomass Removal	Habitat Alteration	Ghost Nets	Discards at Sea	Oil Spills and Pollution	Industrial Effluents	Temperature and Salinity Change	Increased UV Radiations
Bottom Trawl	N	N	–	–	–	–	–	–
Scallop Dredge	–	N	–	–	–	–	–	–
Gillnet	Y	N	N	–	–	–	–	–
Purse Seine	Y	–	N	–	–	–	–	–
Jigging Machine	Y	–	–	–	–	–	–	–
Mackerel Trap	Y	–	–	–	–	–	–	–
Tuck-Ring Seine	Y	–	–	–	–	–	–	–
Hand Line	Y	–	–	–	–	–	–	–
Unreported Bait Fishing	N	–	–	–	–	–	–	–
Dredging	–	N	–	–	–	–	–	–
Vessel Traffic	–	–	–	–	Y	–	–	–
Industrial Activities	–	–	–	–	–	Y	–	–
Human Activity Induced Climate Change	–	–	–	–	–	–	N	N

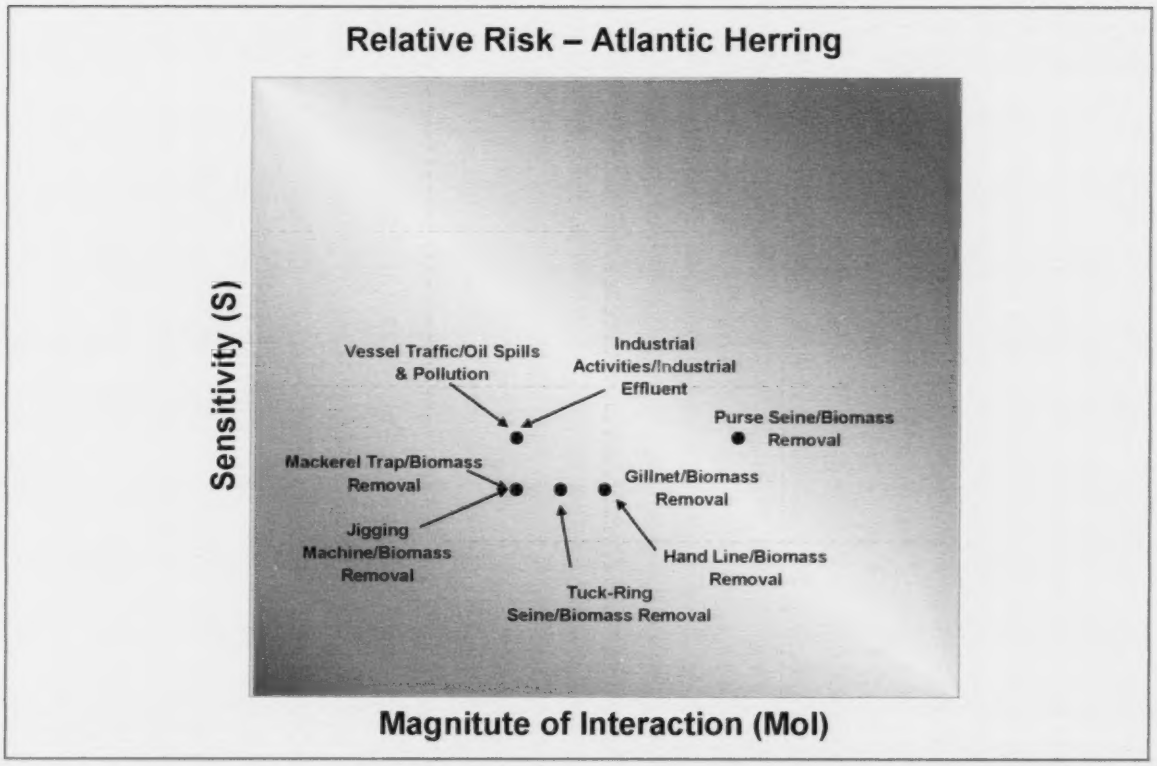
Y = Activity/Stressor screened in;
N = Activity/Stressor screened out;
– = Irrelevant

Eighteen (18) activities / stressors were considered in the mackerel vulnerability analysis: Bottom Trawl / Biomass Removal – Habitat Alteration, Scallop Dredge / Habitat Alteration, Gillnet / Habitat Alteration – Biomass Removal – Ghost Nets, Purse Seine / Biomass Removal - Discards at Sea, Jigging Machine / Biomass Removal, Mackerel Trap / Biomass Removal, Tuck-Ring Seine / Biomass Removal, Hand Line / Biomass Removal, Unreported Bait Fishing / Biomass Removal, Dredging / Habitat Alteration, Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluents, Human Activity Induced Climate Change / Temperature and Salinity Change – Increased UV Radiations.

Excluded (10) – There is likely no physical interaction between mackerel (i.e., eggs) and habitat alterations caused by bottom trawl, scallop dredging or dredging. Pelagic gillnets do not significantly alter its habitat. As the available data are inadequate to assess the impacts of biomass removal by bait fishing and discard at sea (Purse Seine) on mackerel, this activity was not retained. According to François Grégoire (DFO, pers. comm.), incidental catches of mackerel by bottom trawls and ghost fishing using gillnets are negligible on mackerel populations in the Estuary and Gulf of St. Lawrence.

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (8) – Mackerel is a target species for harvesting with the following fishing gear in the Estuary and Gulf of St. Lawrence: purse seine, pelagic gillnet, handline, mackerel trap, jigging machine and tuck-ring seine. The St. Lawrence Seaway is a major maritime route, which increases the potential for oil spills and pollution. A substantial amount of industrial activity (industrial effluents) such as mining (extraction and refining) and pulp and paper occurs along the shores of the St. Lawrence River.



Relative risk profile: Due to its relatively high resilience, the mackerel species is not very sensitive to disturbances. Although this is mainly a target species for purse seine fishing, pelagic gillnets and handlines also contribute to the majority of mackerel landings. To a lesser extent, some landings are made with mackerel traps and jigging machines. According to the vulnerability profile, the use of theses gear does not appear to cause any problems. However, it is essential to confirm this information with experts (fishery managers and scientists) to determine whether the cumulative effect of these gear could negatively impact the mackerel in the St. Lawrence.

Oil spills from vessel traffic could have considerable effects on this species if they coincide in time and space. Finally, according to our analysis, industrial effluents should not cause a major impact on this species.

Appendix B61: Atlantic Mackerel (*Scomber scombrus*) (continued)

Biology/Distribution The Atlantic mackerel (*Scomber scombrus*) belongs to the order Perciformes, family Scombridae and genus Scomber. Of the three species of the genus Scomber, it has the most northerly distribution. It is also the only fish in this genus that does not have a swim bladder, which may explain why they are always moving in order to maintain their position in the water column. A pelagic fish, mackerel makes lengthy annual transborder migrations in the spring and fall (wintering in the continental shelf of the United States, on Georges Bank), sometimes in very dense schools. These schools and their rapid swim speed enable them to escape their prey more easily while also helping them feed[1, 2]. Mackerel can live up to 18 years[3].

The mackerel that frequent Canadian waters spawn mainly in the southern Gulf of St. Lawrence, starting in late May but mostly in June and July. The largest concentrations of eggs are usually found in the waters south of the Laurentian Channel, west of the Magdalen Islands, where water temperatures are at least 10ºC[1, 2, 4]. At the peak of the spawning period, water temperature varies between 9ºC and 12ºC, and at these temperatures, egg incubation time lasts around one week. Spawning is described as multiple because each female spawns several times, and asynchronous because it can occur at any time of day or night. Spawning occurs near the surface, and during incubation, eggs are found floating in water layers above the thermocline[2]. According to surveys conducted by François Grégoire in the southern Gulf (F. Grégoire, DFO, pers. comm.), mackerel eggs are found almost exclusively in the first 10 metres of the water column, and adults in the first 50 metres. The spawning season proceeds in phases as water temperatures rise and as the mackerel migrate from south to north[5]. Most spawning females are very fertile, producing from 200,000 to 500,000 eggs[3].

Mackerel feed on plankton (small crustaceans, fish eggs and larvae) as well as smaller fish such as capelin and young herring and mackerel. It feeds selectively, either by active search or by filter feeding. Its main predators include whales, seals, tuna, sharks, seabirds (e.g., gannet), cod and squid[3].

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[1] MPO. 2007. Évaluation du stock de maquereau bleu du nord-ouest de l'Atlantique (sous-région 3 et 4) en 2006. Secr. can. de consult. sci. du MPO, Avis sci. 2007/012: 20 p.

[2] MPO. 2004. Maquereau bleu du nord-ouest de l'Atlantique en 2003. Secr. can. de consult. sci. du MPO, Rapp sur l'état des stocks 2004/018: 13 p.

[3] MPO. 1993. Le maquereau bleu, In *Collection "Le Monde sous-marin"* (Ministère des Pêches et Océans, Ed.), 6 p.

[4] Grant, S.M. En préparation. Life history and habitat requirements of marine finfish species occurring in the Newfoundland and Labrador region. *Submitted to Department of Fisheries and Oceans, Northwest Atlantic*, 267 p.

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Expert consulted: François Grégoire. MPO-DFO Mont-Joli – Québec.

Appendix B612: Atlantic Cod (*Gadus morhua*)

Scoping:

Activities/ stressors	Biomass Removal	Habitat Alteration	Ghost Nets	Noise and Disturbance
Bottom (otter) Trawls	Y	N	--	--
Gillnets	Y	--	N	--
Longlines	Y	--	--	--
Handlines	Y	--	--	--
Danish and Scottish Seines	Y	--	--	--
Midwater Trawl	N	--	--	--
Traps	N	--	--	--
Seismic	--	--	--	N

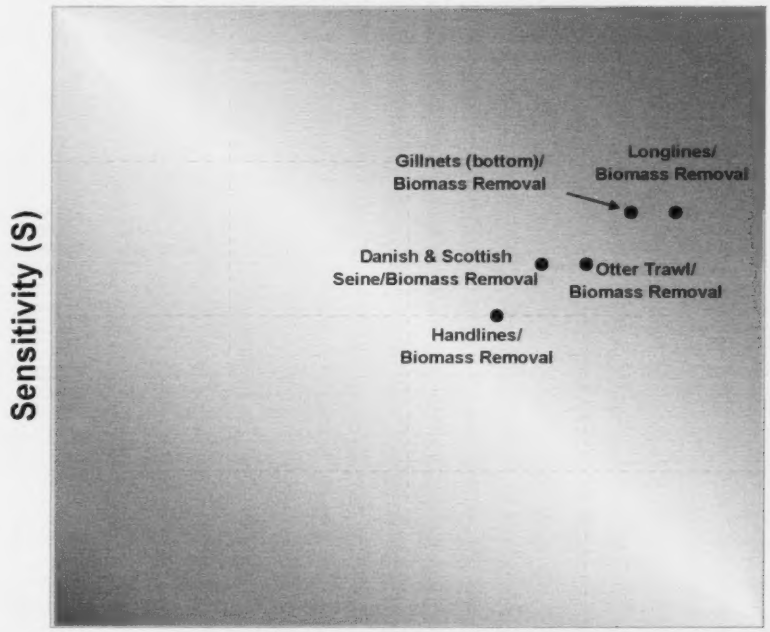
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Ten (10) activities / stressors were initially considered: Bottom (otter) Trawls / Biomass Removal – Habitat Alteration, Gillnets (bottom) / Biomass Removal – Ghost Nets, Longlines / Biomass Removal, Handlines / Biomass Removal, Danish and Scottish Seines / Biomass Removal, Midwater Trawl / Biomass Removal, Traps / Pots / Biomass Removal and Seismic Survey/ Noise and Disturbance. A variety of human activities / stressors were considered (e.g. Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluent, Dredging / Habitat Alteration and Human Activity-Induced Climate Change), however only those deemed to have the potential for significant effects on the species were included in the scope of the analysis.

Excluded (5) – Midwater trawl has not been in use in the Estuary and Gulf since 1990's and since the shrimp fishery began using Nordmore Grates at the opening of the trawl nets (late 90's), the by-catch of groundfish, has basically been eliminated. Traps/pots have minimal catches of cod compared to other gears. Ghost nets represent the same basic threat to fish as their deliberately set counterparts however in any given area they are not as numerous as deliberately set fishing gear. As time passes, they become less and less efficient at fishing since they become fouled and floats either are degraded or otherwise lose their ability to suspend the net off bottom. In regard to habitat alteration by bottom trawls, eggs are buoyant and float in water and therefore are not affected. The bottom trawl would have impact on the young cod, but mainly through biomass removal which is taken into account in that section of the analysis. For seismic effects, there is no evidence to support the concern that noise and pressure changes associated with conventional seismic surveys impact on juvenile finfish, including eggs and larvae of finfish[4].

Included (5) – Four (4) fishing gears were included in the vulnerability profile for Atlantic cod all related to biomass removal. These include gillnets (bottom), longlines, handlines, bottom trawl and Danish and Scottish seines. All these gears are used in directed or by-catch fisheries for cod.

Relative Risk – Atlantic Cod



Relative risk profile: Atlantic cod is most vulnerable to longlines and bottom gillnets. Longline distribution has the greatest overlap (75-95%) with the cod distribution, while bottom trawl and bottom gillnets have a 25-75% overlap and handlines and Danish/Scottish seines have a 5-25% overlap. Qualitative risk assessment fishing gear assigns contact at greater than 75% for non-commercial by catch of bony fishes which is the highest category in this scale. These gears are designed to capture demersal species thus there is expected to be full contact between the gear and the species (>95%). Cod are found within the GSL throughout the year. All gears have a potential to be in use between April and November/December except for handlines which are used between July and October. Therefore duration of activity with species occurrence is considered greater than 95% for all gears. Longlines and bottom gillnets have high intensity (75-95%) even though bottom gillnets remove a larger amount of cod. Bottom trawls and seines are at similar levels in the profile for intensity (25-75%). Handlines have the least intensity (5-25%).

Acute and chronic impacts from longlines and gillnets are considered to be high since most of the cod landings come from these two gears. Impacts from bottom trawls and Danish/Scottish seines are considered in the medium range whereas cod are least vulnerable to handline gear. Atlantic cod is a population that has been severely depleted over the last few decades and continues to experience a lack of recovery in the population. The cod population in the southern GSL is currently at a low level of productivity. Assuming that this low level of productivity persists into the future, the population is expected to steadily decline even with no fishery[1]. Currently, estimated natural mortality has increased over the last few years possibly due to an increase in seal consumption and an increase in unaccounted mortality from discards and the recreational fishery[3]. Cod has been identified by COSEWIC and listed as a species of "Special Concern". Given all these factors above and the lack of recovery in the population, Atlantic cod is considered have low resilience, that is, the population is highly sensitive to any biomass removal from fishing. Atlantic cod function as both predator and prey in the ecosystem. The loss or significant decline of this species would represent a medium disruption to the ecosystem function.

Appendix B62: Atlantic Cod (*Gadus morhua*) (continued)

Biology/Distribution: Atlantic cod (*Gadus morhua*) is a demersal species that is commonly found in the Estuary and Gulf of St. Lawrence (EGSL). Cod are long lived and may reach ages of 20 years or more[1]. Female cod produce about two million to 11 million eggs depending on size. The eggs are buoyant, round and about 1 to 2 mm in diameter. They float in water of about 30% salinity (coastal surface water). The eggs rise and remain at or near the surface while they are hatching. The newly hatched larvae (about 5 mm long) depend on the yolk sac for food and at about 4 cm, the young cod settle to the bottom and feed there or near the bottom. Young cod fry feed mainly on copepods, amphipods, and other small crustaceans. Juveniles feed mainly on shrimp, amphipods, euphausiids, and other crustaceans. Adult cod have a wide diet, but feed mainly on a variety of fish species as well as inverterbrates[2]. Cod start maturing at age 4 and size at 50% maturity is about 45cm[3].

Northern GSL cod undertake an extensive annual migration. In winter they are found along the southwestern Newfoundland at depths of more than 366 m and in the spring, they migrate towards the west coast of Newfoundland, where spawning begins. During the summer months, the fish continue their migration and disperse into the coastal areas[3]. Southern GSL cod are also very migratory. Spawning takes place from April to early June and during the summer months, the cod are distributed widely while they feed. They begin their fall migration in late November and concentrate along the Laurentian channel. The return migration usually beings in mid-April, dependent on ice conditions[1].

NAFO fishing zones for Atlantic cod in the GSL are 4R and 4S in the northern Gulf and 4T in the southern Gulf. The northern Gulf fishery was under moratorium from 1994-1996. After re-opening in 1997, catches and total allowable quotas (TACs) varied between 3000 and 7500 t since, except during the closure in 2003. Currently, the northern Gulf is the only Atlantic coast cod stock where the directed fishery is only fished with fixed gears: longline, bottom gillnets and handlines. In the southern Gulf, a moratorium was imposed in 1993. In 1998, the fishery re-opened allowing 3000 t for an index fishery. From 1999-2002 the TAC was 6000 t. The directed fishery was closed again in 2003 but re-opened with a TAC of 3000 t in 2004, 4000 t in 2005 and 2006 and from 2007 to 2009 the TAC was 2000 t. Cod are caught in the directed fishery as well as by-catch in other fisheries, mainly the flatfish fisheries. In other fisheries, the by-catch of cod is limited to 5-25% of the target species. The TAC allowed for the cod fishery includes 200 t for the sentinel and scientific surveys[1].

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[1] DFO. 2009. Assessment of Cod in the Southern Gulf of St. Lawrence. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/007. 15 p.

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[3] DFO. 2010. Assessment of cod stock in the northern Gulf of St. Lawrence (3Pn,4RS) in 2009. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/011. 13 p.

[4] DFO. 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Rep. 2004/002. 15 p.

Appendix B623: Minke Whale (*Balanoptera acutorostrata*)

Scoping:

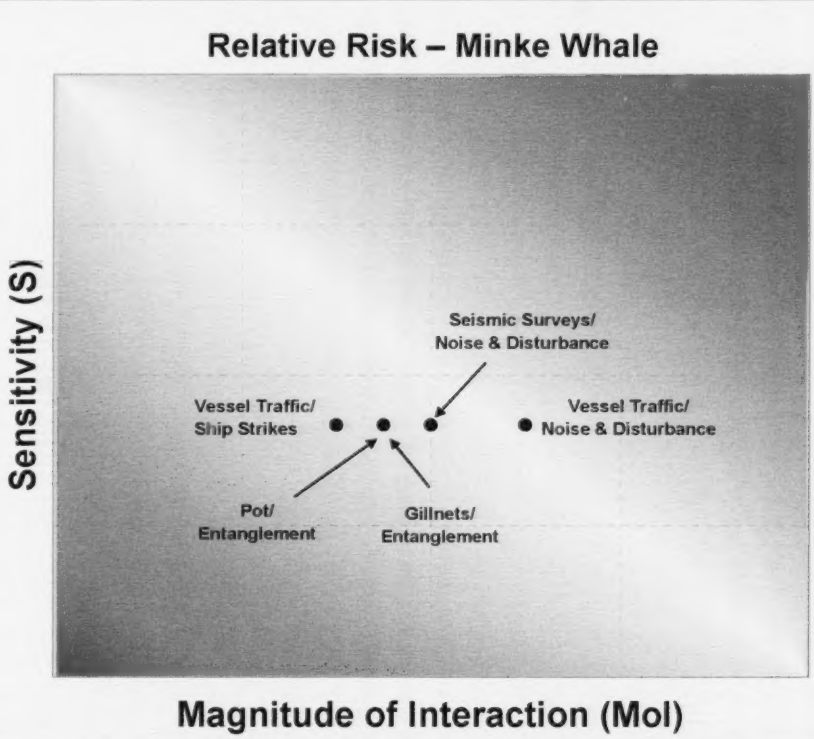
Activities/ stressors	Entanglement	Noise and Disturbance	Ship Strikes and Collisions	Noise and Disturbance	Industrial Effluents	Toxic Algal Blooms
Bottom Trawl	N	–	–	–	–	–
Gillnet	Y	–	–	–	–	–
Pot Gear	Y	–	–	–	–	–
Purse Seine	N	–	–	–	–	–
Vessel Traffic	–	–	Y	Y	–	–
Aquaculture	–	–	–	N	–	–
Seismic Surveys	–	–	–	Y	–	–
Industrial Activity	–	–	–	–	N	–
Submarine Cables	–	–	–	–	N	–
Ecotourism	–	–	N	N	–	–
Ballast Water Exchange	–	–	–	–	–	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Thirteen (13) activities/stressors were initially considered: Gillnet / Entanglement, Pot Gear / Entanglement, Bottom Trawl / Entanglement, Purse Seine / Entanglement, Vessel Traffic / Noise and Disturbance – Ship Strikes and Collisions, Aquaculture / Noise and Disturbance, Seismic Surveys / Noise and Disturbance, Industrial Activity / Industrial Effluents, Submarine Cables / Noise and Disturbance, Ecotourism / Noise and Disturbance – Ship Strikes and Collisions, Ballast Water Exchange / Toxic Algal Blooms.

Excluded (8) – Bottom trawling in the Estuary and Gulf of St. Lawrence has been limited since the mid-1990s, targeting shrimp and some redfish. Purse seines target capelin, herring and mackerel, mainly along near shore waters. While minke whales frequent the same areas, there are very few published reports of whale entanglement in this type of fishing gear. Seabed preparation and installation of submarine cables may result in whales avoiding the immediate area during operations. However, this avoidance behaviour is considered to be temporary and reversible in the short term due to infrequency of this activity. Industrial activities are localized, so the potential for whales to come in contact with industrial effluent and contaminants would be higher at the source and there are few studies supporting the presence of contaminants in baleen whales. Minkes are known to move further upstream in the St. Lawrence Estuary than other whales, but interaction with ecotourism has not been considered an overall issue in the Estuary and Gulf. Finfish aquaculture sites are few in the southern Gulf compared to areas such as Bay of Fundy where high intensity sound devices are more commonly used to deter seals from approaching. It is uncertain what effect, if any, these sound devices have on whales that frequent the area. Ballast water exchange is considered to contribute to an increase in toxic algae, although it is difficult to quantify because of its natural occurrence in the ocean.

Included (5) – Gillnets and pot gear (crab, whelk, lobster) are considered the most problematic type of fishing gear associated with whale entanglement and are widely used throughout the Estuary and Gulf of St. Lawrence. Whale entanglements often go unreported and are also known to be associated with lost fishing gear (ghost nets). Seismic activity related to oil and gas exploration occurs frequently in some areas of the Estuary and Gulf and studies have shown that some species of cetaceans may develop avoidance behaviour to this activity. Vessel traffic is high throughout the Estuary and Gulf with the majority en route to the St. Lawrence seaway, but also to ports along all five provinces. Collisions between vessels and whale are considered a major source of whale mortality throughout global waters, although many collisions go unreported. Large vessels also produce sound frequencies between 20 and 200 Hz, within the hearing range of baleen whales and whales may adopt a variety of reactions to marine noise[5].



Relative risk Profile: All the activities and stressors included in the vulnerability analysis have potential for direct physical contact with minke whales in the Estuary and Gulf of St. Lawrence. While minke whales are one of the most abundant species, their numbers are relatively low, making them susceptible as a group to mortality from anthropogenic sources. However, their wide distribution both inside and outside the Estuary and Gulf may increase their resilience to perturbations overall. Next to humpbacks, minkes are the most commonly reported species to be entangled in fishing gear such as gillnets. Pot gear is also a concern for larger whales but less so for minkes. Next to gillnet entanglement, noise either from vessel traffic or seismic surveys may pose potential problems for minkes. Baleen whales use low frequency sounds to communicate and are considered sensitive to seismic bursts. Exposure to seismic and other sources of low level noise can result in displacement and/or migratory diversion in some marine mammals, but this effect is species, individual, and contextually-related. The ecological significance of such effects is unknown, but there are conditions under which the worst-case scenarios could be high[6].

Appendix B63: Minke Whale (*Balanoptera acutorostrata*) (continued)

Biology/Distribution: Minke whales were the second most frequently observed species (after harbour porpoise) in aerial surveys of the Estuary and Gulf of St. Lawrence[1]. Minke whales were ubiquitous in the Estuary and Gulf, although they were observed more frequently and in higher densities along the north shore shelf, including the Strait of Belle Isle. Ariel surveys of the entire Estuary and Gulf during August/September 1995 and the northern Gulf during July/August 1996 provided population estimates of 1,000 and 600 respectively. They are known to move further upstream in the St. Lawrence Estuary than other whales[2]. Minkes are the smallest of the baleen whales and one of the most abundant whales in the world. The north Atlantic population migrates northward in spring, with many reaching eastern Canadian waters by April. In recent years, large concentrations have been sighted off Labrador. Along inshore waters, minke whales are relatively solitary and even when several are spotted in the same general area, they tend to space themselves apart[3]. Year round sightings suggest that some minkes may be permanent residents in eastern Canadian waters[4]. Minke whales reach sexual maturity at age seven, can give birth every year and have a lifespan of fifty years. Minkes are opportunistic feeders; their diet varying from fish (ex. capelin) to invertebrates (ex. krill) depending on location and time of the year[2].

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Appendix B634: Harp Seal (*Pagophilus groenlandicus*)

Scoping:

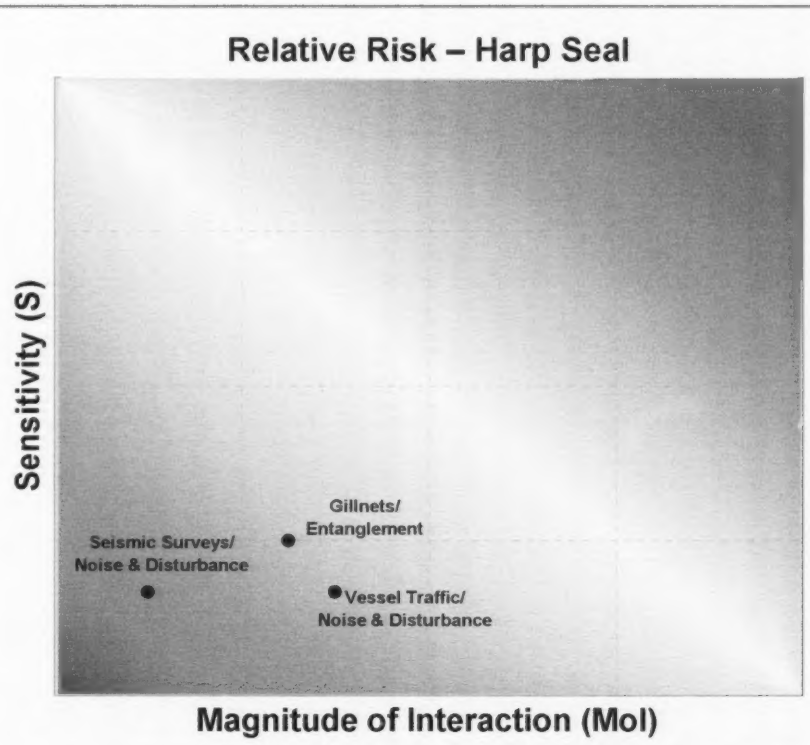
Activities/ stressors	Entanglement	Biomass Removal	Noise and Disturbance	Ship Strikes and Collisions
Gillnets	Y	–	–	–
Seal Hunt	–	N	–	–
Vessel Traffic	–	–	Y	N
Seismic Surveys	–	–	Y	–

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Five (5) activities/stressors were initially considered: Gillnets / Entanglement, Seal Hunt / Biomass Removal, Vessel Traffic / Noise and Disturbance – Ship Strikes and Collisions, Seismic Surveys / Noise and Disturbance.

Excluded (2) – Published documents on ship strikes rarely mention encounters with seals or dolphins. A commercial seal hunt is directed at a large portion of the harp seal population that enters the Estuary and Gulf. However, the hunt is prohibited in whelping areas and is concentrated in areas where harp seals congregate to molt. In recent years, catches have been well below the TAC as a result of reduced fishing effort due to poor ice conditions and weaker markets. While the hunt is directed at the harp seal population, it does not appear to have a negative impact on the overall harp seal population.

Included (3) – Gillnets are a continuing source of entanglement. The Newfoundland lumpfish fishery is believed to be responsible for the largest by-catch mortality of seals. Numbers caught were generally below 1,000 prior to 1976; increased to over 10,000 in some years during the late 1980s and early 1990s, to an estimated high of 46,400 in 1994; but has declined in recent years[5]. This high variation is thought to be largely due to variation in fishing effort. By-catch mortality has not been estimated for other fisheries. However, about two to three captures of seals per year in herring gillnets are reported offshore of Trois-Pistoles[6]. Vessel traffic is considered to be extensive in the Estuary and Gulf, mainly traffic entering the St. Lawrence seaway, but also ports in all five Provinces. Seismic surveys have been conducted throughout the Estuary and Gulf since the 1960s and are expected to continue over the next 10 years as interest in oil and gas exploration increases. Noise generated from vessel traffic and seismic surveys are known to affect the behaviour of some marine mammals, but little information exists regarding the impacts on seals.



Relative risk profile: Harp seals are not considered highly vulnerable to either of the potential activity/stressors included in the vulnerability profile index.

Harp seals are attracted to fish caught in gillnets[7] and they are often observed entering and exiting fishing gears without being caught. Entanglements are known to occur although rarely reported. However, by-catches do not seem to have a negative impact on the overall population of harp seals.

Propagation of sound from commercial and fishing vessel traffic and seismic surveys occurs throughout the Estuary and Gulf. However, while there is concern that prolonged and frequent use of airgun arrays could cause behavioural changes, loss of hearing and masking or modifying of vocalization, there is an absence of reported information regarding migratory or feeding patterns in harp seals. There are no documented cases of marine mammal mortality from exposure to oil and gas exploration seismic surveys[8]. Exposure and sensitivity to noise/disturbance is considered to be low-moderate overall; mainly because animals are either not present or are able to move away from an area of disturbance.

Appendix B64: Harp Seal (*Pagophilus groenlandicus*) (continued)

Biology/Distribution: Harp seals are the most abundant pinniped in Atlantic Canada. In the Estuary and Gulf of St. Lawrence, aerial surveys show higher concentrations in the Belle-Isle/Esquiman Channel/Mecatina Plateau area in the northeastern Gulf[1]. The northwest Atlantic harp seal population summers in the eastern Canadian Arctic and off Greenland; migrating southward in the fall with approximately ⅓ of the population entering the Estuary and Gulf of St. Lawrence through the Strait of Belle Isle by mid-December. In the Estuary and Gulf, harp seals give birth on pack ice during February and March[2]. A large whelping patch typically forms approximately 80 km north of the Magdalen Islands. Females nurse their pups for about 12-14 days, then mate and disperse. Pups remain on the ice two to three weeks after weaning. Some appear to follow the ice through the Cabot Strait, while others move north along western Newfoundland, exiting the Strait of Belle Isle by June[3]. Older harp seals form large molting concentrations on the sea ice in the northern Gulf during April and May. After molting, harp seals disperse and eventually migrate northward through the Strait of Belle Isle[1]. In the Estuary and Gulf, capelin, Atlantic herring, redfish, Atlantic cod, flounder and euphausiids (invertebrates) are known to form a large part of the harp seals' diet. Feeding during the breeding season is thought to be minimal in the southern Gulf[4].

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Appendix B645: Grey Seal (*Halichoerus grypus*)

Scoping:

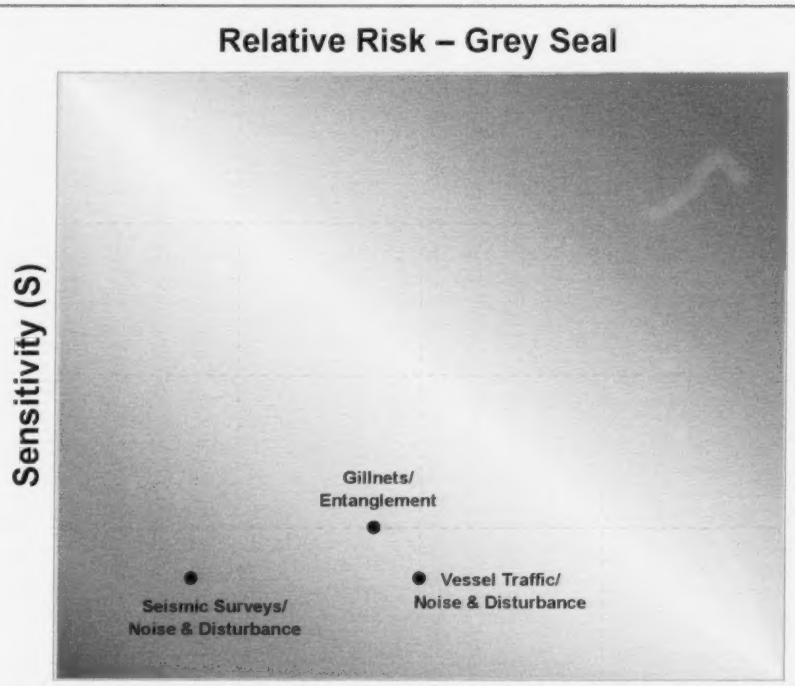
Activities/ stressors	Entanglement	Biomass Removal	Noise and Disturbance	Ice Distribution	Increased Storms and Surges	Temperature and Salinity Change	Sea Level Rise	Change in Ocean Currents
Gillnets	Y	–	–	–	–	–	–	–
Seal Hunt	–	N	–	–	–	–	–	–
Vessel Traffic	–	–	Y	N	–	–	–	–
Seismic Surveys	–	–	Y	–	–	–	–	–
Human Activity Induced Climate Change	–	–	–	N	N	N	N	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Ten (10) activities/stressors were initially considered: Gillnets / Entanglement, Seal Hunt / Biomass Removal, Vessel Traffic / Ice Distribution – Noise and Disturbance, Seismic Surveys / Noise and Disturbance, Human Activity Induced Climate Change / Ice Distribution – Increased Storms and Surges – Temperature and Salinity Change – Sea Level Rise – Change in Ocean Currents. Most of these were excluded either because of limited activity overall in the area or because their location and timing were unlikely to coincide with presence of grey seals.

Excluded (7) – Grey seals as with other seal species are no longer hunted as in the past. However, there is still a commercial hunt for grey seals in the Estuary and Gulf of St. Lawrence (12,000 in 2008). The biomass removal of grey seals is considered to be well within the limits of sustainability. For this reason, the seal hunt is not considered a threat to this species. The effect of vessel traffic on ice distribution would be a concern for nursing grey seals and their pups. The stability of the ice is important for females to successfully rear their young, since suckling occurs only on the ice. It is also important for pups, which remain on the ice for a further two to three weeks. Without access to stable ice to rest, the pups quickly tire and often drown or die. However, vessel traffic is low or non-existent (fish vessels) in ice covered coastal areas during the period when grey seals are using the area (end of December to January) – ex. the Canso canal through which shipping vessels pass to enter St. Georges Bay is only operational between April 14 and December 23 and remains closed due to ice cover during the winter months. Changes anticipated in future ice distribution, as well as associated factors such as temperature, sea level rise and storm surges, could have consequences for seals that use the ice for whelping and nursing. However, none of these stressors are expected to lead to significant impacts over the next decade and are not considered further in this analysis.

Included (3) – Gillnets are a known source of entanglement for seals and other marine mammals, but often go unreported. There is no systematic survey for by-catch mortality of seals in the Estuary and Gulf of St. Lawrence. However, gillnet fisheries occur throughout the Estuary and Gulf of St. Lawrence including in the southern Gulf where grey seals congregate to breed and whelp. Grey seals, like other seals, are attracted to fish caught in fixed fishing gears (e.g. crab traps, gillnets)[9]. They are often observed entering and exiting fishing gears without being caught. The Newfoundland lumpfish fishery is believed to be responsible for the largest by-catch mortality of seals (including grey seals). Noise and disturbance from commercial vessel traffic and seismic surveys may be a concern for nursing seals during whelping periods; although both activities are relatively limited in the area during this time. The lack of ice coverage during some years due to changes in climate is a concern for seals including grey seals, particularly during whelping periods.



Relative risk profile: All the activities and stressors included in the vulnerability analysis had potential for direct physical contact with grey seals when they occurred together. However, overall vulnerability to these activities/stressors was considered to be low. One reason for this was because the overall abundance of grey seals is considered to be healthy and sustainable at current harvest levels. They are considered relatively resilient to perturbation.

Appendix B65: Grey Seal (*Halichoerus grypus*) (continued)

Biology/Distribution: The northwest Atlantic population of grey seals (*Halichoerus grypus)* ranges from Labrador to New England, with two breeding concentrations; one on Sable Island and the other in the southern Gulf of St. Lawrence[1]. Grey seals represent the second most abundant pinniped species in the Estuary and Gulf of St. Lawrence[2]. They are primarily summer residents to the area, but some animals occupy the Estuary and Gulf year round. During the ice-free period, grey seals concentrate in the area to the west of Anticosti, between the Banc Parent and the north shore, and the shelf of the western Gulf all along the Gaspé Peninsula, the Miramichi area, Northumberland Strait and northwest of Cape Breton, including the trough area[3]. Both Sable Island and southern Gulf populations occupy the Estuary and Gulf during the ice-free period, but the number of individuals present in the St. Lawrence system during this period, although in the thousands, remains uncertain. A southward migration occurs during October/November to areas outside the Estuary and Gulf along the Scotian Shelf and south of Newfoundland, with a core distribution remaining in the southern Gulf[2, 4]. This southern Gulf population gathers in breeding colonies, with whelping occurring from December to February on small islands off Nova Scotia and Cape Breton (Amet Island and Hay Island) and the Îles-de-la-Madeleine (Deadman Island), as well as pack ice between Prince Edward Island, Nova Scotia and Cape Breton[4]. Grey seals disperse offshore after whelping and many are thought to congregate on Sable Island during May and June to moult[3]. The southern Gulf population was estimated at 69,000 during the late 1990s[5]; however, aerial survey data from 1997 to 1999 suggests the population may be declining[6]. In the northern Gulf, capelin, Atlantic cod, Atlantic herring, lumpfish and flat fishes are important prey; while in the southern Gulf, skates (*Raja* spp.), flatfishes, herring, cod, and rainbow smelt dominated the diet[7]. Invertebrates do not appear to be an important part of the grey seals' diet in the Estuary and Gulf of St. Lawrence[8].

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1. Boskovic, R., Kovacs, K.M., and Hammill, M.O. 1996. Geographic distribution of mitochondrial DNA haplotypes in grey seals *Halichoerus grypus*. Can. J. Zool. 74: 1787-1796.
2. Lesage, V., Gosselin, J.-F., Hammill, M.O., Kingsley, M.C.S., and Lawson, J. 2007. Ecologically and Biologically Significant Areas (EBSAs) in the Estuary and Gulf of St. Lawrence – A marine mammal perspective CSAS 2007/046. 96 p.
3. Lavigueur, L., and Hammill, M.O. 1993. Distribution and seasonal movements of grey seals, *Halichoerus grypus*, in the Gulf of St. Lawrence. Can. Field-Nat. 107: 329-340.
4. Mansfield, A.W., and Beck, B. 1977. The grey seal in eastern Canada. Canada, Department Environment, Fish. Mar. Serv. Tech. Rep. 704: 81 p.
5. Hall, A. 2002. Gray seal, *Halichoerus grypus*. p. 522-524 *in* W.F. Perrin, B. Wursig and J.G.M. Thewissen (eds.), Encyclopedia of Marine Mammals. Academic Press, San Diego, California. 1414 p.
6. Hammill, M.O., Lesage, V., Dubé, Y., and Measures, L.N. 2001. Oil and gas exploration in the southeastern Gulf of St. Lawrence: a review of information on pinnipeds and cetaceans in the area. CSAS Research Document 2001/115. 39 p.
7. Benoit, D., and Bowen, W.D. 1990. Summer diet of grey seals (*Halichoerus grypus*) at Anticosti Island, Gulf of St. Lawrence, Canada. p. 227-242 in W.D. Bowen (ed.), Population biology of sealworm (*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. Can. Bull. Fish. Aquat. Sci. 222.
8. Hammill, M.O., and Stenson, G.B. 2000. Estimated prey consumption by harp seals (*Phoca groenlandica*), hooded seals (*Cystophora cristata*), grey seals (*Halichoerus grypus*) and harbour seals (*Phoca vitulina*) in Atlantic Canada. J. Northw. Atl. Fish. Sci. 26: 1-23.
9. Farmer, P., and Billard, A. 1984. Gear damage in the Nova Scotia inshore fishery. Can. Ind. Rep. Fish. Aquat. Sci. 156p.

Appendix B656: American Plaice (*Hippoglossoides platessoides*)

Scoping:

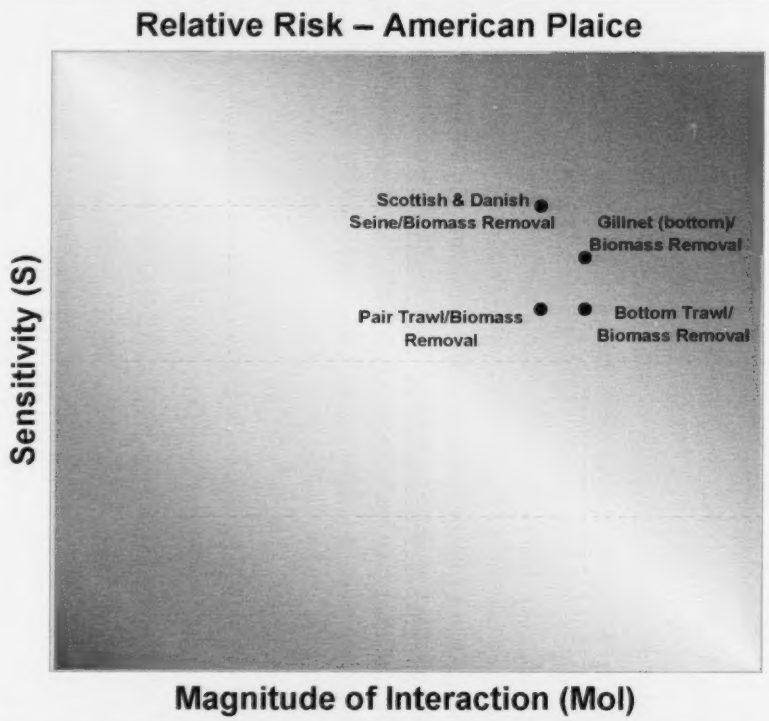
Activities/ stressors	Biomass Removal	Habitat Alteration	Ghost Nets	Noise and Disturbance
Bottom Trawls	Y	N	--	--
Scallop Dredge	N	N	--	--
Gillnets	Y	N	N	--
Danish and Scottish Seines	Y	N	--	--
Longlines	N	N	--	--
Handlines	N	--	--	--
Pair Trawl	Y	N	--	--
Midwater Trawl	N	--	--	--
Shrimp Trawl	N	--	--	--
Seismic Surveys	--	--	--	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Seventeen (17) activities / stressors were initially considered: Bottom (otter) Trawls / Biomass Removal – Habitat Alteration, Scallop Dredge / Biomass Removal – Habitat Alteration, Gillnets (bottom) / Biomass Removal – Habitat Alteration – Ghost Nets, Danish and Scottish Seines / Biomass Removal – Habitat Alteration, Longlines / Biomass Removal – Habitat Alteration, Handlines / Biomass Removal, Pair Trawl / Biomass Removal – Habitat Alteration, Midwater Trawl / Biomass Removal, Shrimp Trawl / Biomass Removal, Seismic Surveys / Noise and Disturbance. A variety of human activities / stressors were considered (e.g. Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluent, Dredging / Habitat Alteration and Human Activity-Induced Climate Change), however only those deemed to have the potential for significant effects on the species were included in the scope of the analysis.

Excluded (13) – Longlines and handlines accounted for only 2% and 1% of landings in the American plaice fishery, respectfully. Scallop dragging has a potential for by-catch of groundfish, but likely occurs in shallow areas outside of the American plaice habitat. Midwater trawls have not been in use in the Estuary and Gulf since the 1990's. Since the shrimp fishery began using Nordmore Grates, the by-catch of groundfish, has basically been eliminated. Given the location, nature, and reduced intensity of these gears and given that disruptions to the ocean floor would only provide very short-term impacts (i.e., food sources may be disturbed within the reaches of the trawl), it is not believed that habitat alteration by these gears will significantly impact this species. Ghost nets are not as numerous as deliberately set fishing gear (estimates are in the range of 5%) and with time they become less efficient at fishing due to fouling and degraded floats. There is no conclusive evidence to support the concern that noise and pressure changes associated with conventional seismic surveys impact finfish[2, 3].

Included (4) – Seines were the most common gear used in this fishery during the 2000-2007 period with 59% of landings captured by seines. Gillnets (bottom) accounted for 17% of landings, bottom trawls accounted for 11% of landings, and pair trawls accounted for 10% of landings of American plaice during this period.



Relative risk profile: In the GSL, there is a 25-75% overlap of the species distribution with the distribution of bottom trawls and the distribution of gillnets. Scottish/Danish seines and pair trawls each have a 5-25% overlap with the species distribution. These gear types are designed to capture demersal species, thus full contact is expected when the gears coincide with the species. Taking into account the temporal presence of American plaice in the GSL and the months in which fish harvesters use bottom trawls, seines, bottom gillnets, and pair trawls, the overlap between the occurrence of American and these gears would be greater than 95%. According to the logbook data, the intensity of bottom trawling, seining, bottom gillnets and pair trawls relative to the species distribution are each considered to be in the moderate range (25-75%).

Though widely distributed, this species has experienced major declines mostly caused by overfishing. The adult growth rate has been low since the early 1980's and natural mortality has been high. The spawning stock biomass is low and further declines are projected even in the absence of fishing. Prospects for rebuilding this stock are poor[1]. COSEWIC has listed the Maritime and Newfoundland and Labrador populations as threatened[4]. Given these issues and considering the landings by these gear types, the overall impact of bottom trawling and pair trawls on the species and their habitat is expected to be in the medium range, while the impact of bottom gillnets is expected to be high and seines are expected to be very high. American plaice function as both predator and prey in the ecosystem. The loss or significant decline of the species would represent a medium disruption to the ecosystem function. Given that the state of the stock, the sensitivity of the population is expected to be very high.

Biology/Distribution: American plaice (*Hippoglossoides platessoides*) are distributed throughout the Northwest Atlantic ranging from western Greenland to the Gulf of Maine. During summer, they are distributed in intermediate depths (80-250 m) and cold waters (below 0 °C to 1.5 °C). In winter, southern Gulf plaice move to warmer deeper channel waters, at which time they cease feeding[1]. Female plaice grow faster and larger than males and males have shorter lifespans. Females reach sexual maturity between 7 and 15 years of age, while male sexual maturity occurs between 5 and 7 years of age. Hundreds of thousands of eggs are released during spawning, which occurs from early spring to summer. The fertilized eggs float near the water surface for several days before hatching. Larvae are pelagic until they reach a minimum length of 18 mm becoming benthic after metamorphosis[1]. Young plaice prey on bottom organisms such as mysid shrimp, amphipods, polychaetes, echinoderms and mollusks, while older plaice eat other small fish species and invertebrates[1].

In the GSL, landings and fishing effort have declined sharply in recent years (476 mt in 2005; 490 mt in 2007). In addition to a reduced TAC, several management measures have been introduced[1]. Key indicators for the stock are presently near the lowest values ever observed. There has been a decline in the growth rate of adults since the early 1980s. Despite recent declines in fishing effort average total mortality has been 0.54 since 1992, which is near the long-term average since 1971. Natural mortality estimates are very high and account for almost all of total mortality[1]. The spawning stock biomass is low and it is projected that it will decline by 2.4% even in the absence of fishing. Under the current conditions, the prospects for rebuilding this stock are poor. Rebuilding the stock would require both an increase in productivity and a minimum level of harvesting[1].

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[1] DFO. 2008. Assessment of American plaice in the southern Gulf of St. Lawrence (NAFO Div. 4T) in 2007. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/005. 9 p.

[2] DFO. 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Rep. 2004/002. 15 p.

[3] DFO. 2009. National Science Workshop: Review of Scientific Information on the Impacts of Seismic Sound on Fish, Invertebrates, and Marine Mammals Workshop II, 2008; 26-27 March 2008. DFO Can. Sci. Advis. Sec. Proceed. Ser. 008/032.

[4] COSEWIC. 2010. Accessed November 19, 2010. http://www.cosewic.gc.ca/

Appendix B667: Winter Flounder (*Pseudopleuronectes americanus*)

Scoping:

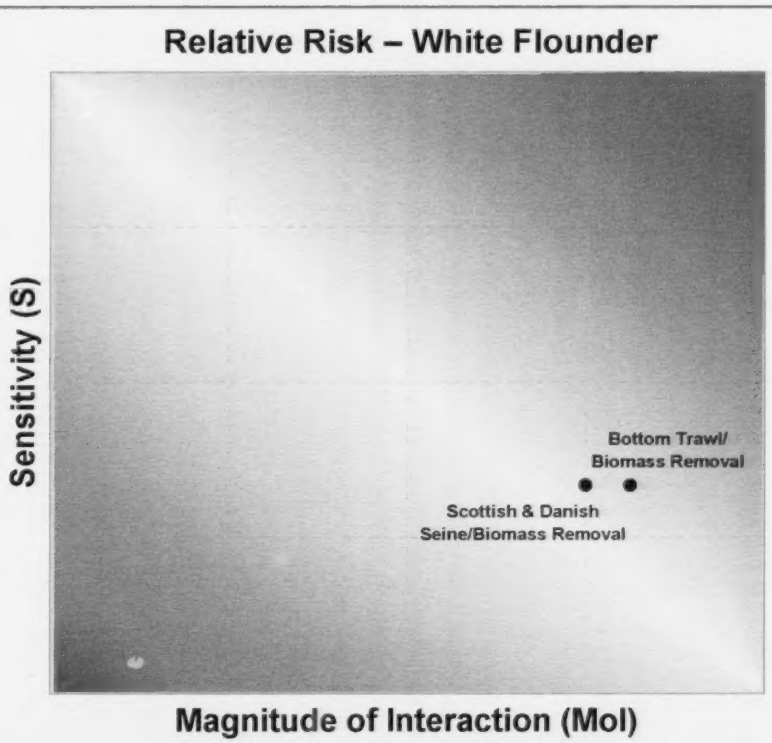
Activities/ stressors	Biomass Removal	Habitat Alteration	Ghost Nets	Oil Spills and Pollution	Noise and Disturbance
Bottom Trawl	Y	N	–	–	–
Scallop Dredge	N	N	–	–	–
Gillnets	N	N	N	–	–
Danish and Scottish Seines	Y	N	–	–	–
Vessel Traffic	–	–	–	N	–
Seismic Surveys	–	–	–	–	N

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Eleven (11) activities/stressors were initially considered: Bottom Trawls / Biomass Removal – Habitat Alteration, Scallop Dredge / Biomass Removal – Habitat Alteration, Gillnets (bottom) / Biomass Removal – Habitat Alteration – Ghost Nets, Danish and Scottish Seines / Biomass Removal – Habitat Alteration, Vessel Traffic / Oil Spills and Pollution, Seismic Surveys / Noise and Disturbance. A variety of human activities / stressors were considered (e.g. Industrial Activities / Industrial Effluent, Dredging / Habitat Alteration and Human Activity-Induced Climate Change), however only those deemed to have the potential for significant effects on the species were included in the scope of the analysis.

Excluded (9) – By-catch rates by scallop drags have been determined to be insignificant by DFO Science. Bottom gillnets accounted for only 0.2% of landings during the period from 2000-2009. Given that this species spawns in estuaries, the reduced intensity of these gears and that disruptions to the ocean floor would only provide very short-term impacts (i.e., food sources may be disturbed within the reaches of the gear) it is not believed that habitat alteration by scallop drags and bottom gillnets will provide a significant impact to this species. Ghost nets are not as numerous as deliberately set fishing gear (estimates are in the range of 5%) and with time they become less efficient at fishing due to fouling and degraded floats. Oil spills in the GSL are rare events. There is no conclusive evidence to support the concern that noise and pressure changes associated with conventional seismic surveys impact finfish [3, 4].

Included (2) – Seines are the most common gear used in this fishery with 71.4% of landings captured by Scottish seines and 0.06% of landings captured by Danish seines during the 2000-2009 period. Bottom trawling accounted for 27.9% of landings during the period from 2000-2009.



Relative risk profile: In the GSL, there is a 75-95% overlap of the species distribution with the distribution of bottom trawling and a 25-75% overlap with the distribution of seines. These gear types are designed to capture demersal species, thus full contact is expected when the gears coincide with the species. When bottom trawling and seining occurs within the Estuary and Gulf, winter flounder have migrated from their overwintering areas (i.e., estuaries). Therefore, taking into account the fact that other fisheries use bottom trawls and seines, the overlap between the occurrence of winter flounder in this area and these gears would be greater than 95%. According to the logbook data, the intensity of bottom trawling and Scottish and Danish seining relative to the species distribution is considered to be in the moderate range (25-75%).

Given that winter flounder are not slow-growing or long-lived species, their relatively stable abundance (varies about the long term mean), and that they are coastal species inhabiting hard bottom and spawning in late winter / early spring, the overall impacts of bottom trawling and seining on the species and their habitat is expected to be in the low range. Winter flounder function as both predator and prey in the ecosystem. The loss or significant decline of the species would represent a low disruption to the ecosystem function. Winter flounder are not particularly fragile at current catch rates and they are neither long lived nor slow to reproduce, however if fishing pressure were to increase to previous, it is likely that this stock would begin to decline. Given the current state of both the stock and the fishery, the sensitivity of the stock is expected to be medium.

Appendix B67: Winter Flounder (*Pseudopleuronectes americanus*) (continued)

Biology/Distribution: Winter flounder is a coastal flatfish species that is distributed from southern Labrador to Georgia in the west Atlantic. They prefer soft or moderately hard bottoms at depths of less than 40 m. Winter flounder are able to inhabit a range of water temperatures including sub-zero water conditions. In the southern Gulf, they migrate seasonally from the coast and overwinter in estuaries[1]. Spawning occurs in late winter or early spring, with each female releasing several hundreds of thousands of eggs. Eggs settle to the bottom and adhere to rocks and vegetation. After hatching, larvae drift to the surface until their metamorphosis, which occurs 2-3 months later. Female winter flounder reach maturity by about 25 cm and males by approximately 20 cm; however growth rates vary widely between regions. The main prey of winter flounder includes a variety of benthic organisms, particularly molluscs and small crustaceans, as well as the eggs of fish, namely capelin and herring[1]. Winter flounders are prey for harbour, harp and grey seals. During the winter months when winter flounder are in deeper water, they are also prey for monkfish, dogfish and sea raven. In summer, they are a common prey of ospreys while blue herons and cormorants prey on young fish[2].

The winter flounder are used for lobster bait and a limited number of food markets. Winter flounder used to be a by-catch in the cod, white hake and American plaice fisheries, though after the closure of the cod fishery, the fishery for winter flounder has become predominately a directed fishery. In some areas of the southern Gulf, winter flounder are captured by setting tangle nets on herring spawning beds[1].

During the 2000-2009 period, landings of winter flounder in the Estuary and Gulf of St. Lawrence have declined significantly with total landings in 2009 of 110 mt. The abundance of winter flounder in the southern Gulf varied about a constant level during the decade leading up to the year 2002. During this period, the abundance index was near the series average, while the biomass index was below average. The average size of winter flounder in the Estuary and Gulf has declined, but appears to be constant in recent years[1].

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[1] DFO. 2005. Winter flounder in the southern Gulf of St. Lawrence (Div. 4T). DFO Can. Sci. Advis. Sec. Rep. 2005/015. 6 p.

[2] Scott, W.B., and Scott, M.G. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.

[3] DFO. 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Rep. 2004/002.

[4] DFO. 2009. National Science Workshop: Review of Scientific Information on the Impacts of Seismic Sound on Fish, Invertebrates, and Marine Mammals Workshop II, 2008; 26-27 March 2008. DFO Can. Sci. Advis. Sec. Proceed. Ser. 008/032DFO.

NOAA 2010. Accessed November 2, 2010: http://www.nmfs.noaa.gov/fishwatch/species/winter_flounder.htm

Appendix B678: Thorny Skate (*Amblyraja radiate*)

Scoping:

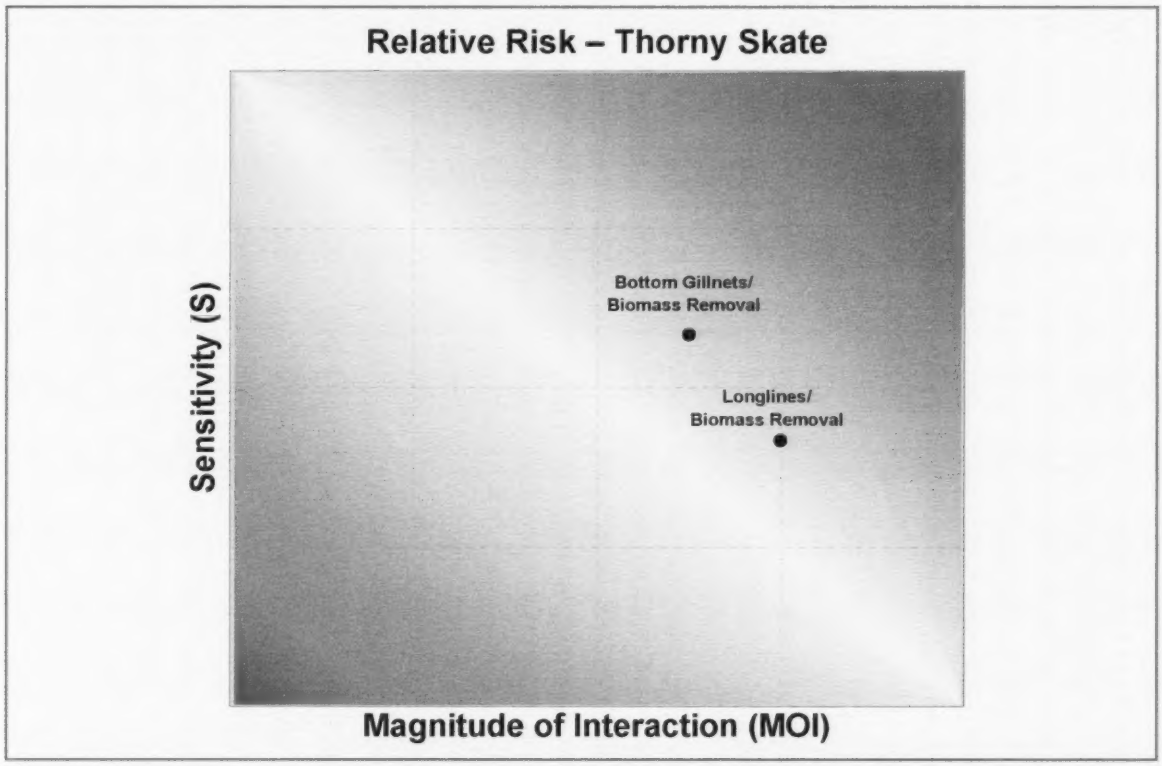
Activities/ stressors	Biomass Removal	Habitat Alteration	Noise and Disturbance
Bottom Trawl	Y	N	–
Gillnet	N	–	–
Longlines	Y	–	–
Scottish and Danish Seines	N	–	–
Handlines	N	–	–
Shrimp Trawl	N	–	–
Seismic Surveys	–	N	–

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Eight (8) activities / stressors were initially considered: Bottom Trawl / Biomass Removal / Habitat Alteration, Gillnet (bottom) / Biomass Removal, Longlines / Biomass Removal, Scottish and Danish Seine / Biomass Removal, Handlines / Biomass Removal, Shrimp Trawl / Biomass Removal, Seismic Surveys / Noise and Disturbance. A variety of human activities / stressors were considered (e.g. Vessel Traffic / Oil Spills and pollution, Industrial Activities / Industrial Effluent, Dredging / Habitat Alteration, and Human Activity-Induced Climate Change), however only those deemed to have the potential for significant effects on the species were included in the scope of the analysis.

Excluded (6) – Many gears have a bycatch of skates which presumably includes thorny skates, which are the most abundant skate species in the Estuary and Gulf. However, total by-catch of skates for NAFO areas 4RST (2000-2009) from Danish seine, Scottish seine, handlines, and shrimp trawl, account for less than 3 % of the total landings of skates from all gears. Bottom trawls account for 5% of the total landings of skates. Biomass removal of thorny skates has been screened out for these gears because by-catch is negligible compared to other gears. Given the location, nature, and reduced intensity of bottom trawls and given that disruptions to the ocean floor would only provide very short-term impacts (i.e., food sources may be disturbed within the reaches of the trawl), it is not believed that habitat alteration by bottom trawl will significantly impact this species. There is no conclusive evidence to support the concern that noise and pressure changes associated with conventional seismic surveys impact finfish[5, 6].

Included (2) – The fishing gears which contribute to most of the by catch of skates in general are bottom gillnets (77%) and longlines (16%).



Relative risk profile: The main stressors to thorny skate come from by catch from fishing gears, predation and temperature related movement[2]. For this reason, only biomass removal from fishing gears was considered. Skates in general are most vulnerable (sensitive) to by-catch in gillnet gear compared to other gears. Both gears have relatively high overlap with the species distribution (25-95%). Qualitative risk assessment fishing gear assigns contact at 25- 75% for skates and rays when using gillnets and longlines for groundfishing. In this case, the determined level of contact is likely but not as high as in a directed fishery. Both gears are used between April and November with 100 % overlap with the presence of skate. Intensity for gillnets is considered moderate since most of the gillnetting occurs outside of the thorny skate distribution. However, the intensity is considered high with longlines as there is more overlap with thorny skate distribution.

Acute and chronic impacts are considered very high for gillnets since most of the by-catch of skates come from this gear but intensity is low for longlines. The loss or significant decline of the species would represent a low disruption to the ecosystem function. Overall biomass of thorny skate in the southern Gulf decreased by about 80% over the 1971-2002 period[1]. No recovery in the abundance of mature skates is evident despite the sharply reduced fishing effort in the southern GSL over the last 10 years[2]. Given these factors, thorny skate is considered to have low to moderate resilience and a very high sensitivity to any biomass removal from fishing activities. Thorny skate function mostly as a predator in the ecosystem. The loss or significant decline of the species would represent a low disruption to the ecosystem function.

Appendix B68: Thorny Skate (*Amblyraja radiate*) (continued)

Biology/Distribution: Thorny skate is the most abundant of the skate species that occur in the Estuary and Gulf of St. Lawrence (GSL) and during the 1970's and 80's were widely distributed in waters shallower than 100 m which cover most of the southern Gulf. However since the 1990's, the thorny skate distribution has been largely restricted to a small area in the NE corner of the Magdalen Shallows and along the slope of the Laurentian Channel in depths greater than 200 m[1]. With the sharp decline in its geographic range in recent years, the population has become highly concentrated in a shrinking area, increasing its catchability to any fisheries and other predators occurring in the remaining portion of its range[1]. Late age-at-maturity, low fecundity and slow growth make these fishes particularly vulnerable to over-exploitation[2]. Overall biomass of thorny skate in the southern Gulf decreased by about 80% over the 1971-2002 period[2]. Thorny skates under 70 cm eat mainly amphipods, polychaetes and decapods while those over 70 cm eat mainly fish. Predation on thorny skate is poorly documented but they may at times fall prey to grey seals[3].

Multi-survey data from the northern Gulf indicate the spatial distribution to be similar to what was previously observed in the northern Gulf since 2002 with abundance higher at depths ranging between 150-250 m with recurrent concentration at the head of the Laurentian Channel[4].

There are no directed fisheries for thorny skate in the GSL however by-catch of thorny skates in other fisheries does occur. By-catch of skates is not identified by species but instead is lumped together and includes thorny skate, winter skate and smooth skate. Reported landings of skates from the southern GSL have always been low however reported landings are a small fraction of actual catches of skates. Most of the skate by-catch is discarded at sea. Based on observed by-catch rates in southern GSL fisheries, estimated annual catches of skates were 1500-2000 t in the early 1990s and 600–900 tonnes in the mid-to late 1990s. Although it has been suggested that discard mortality is relatively low for skates, empirical studies indicate mortality rates of 40% or greater[2].

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[1] Swain, D.P., and Benoît, H.P. 2006. Change in habitat associations and geographic distribution of thorny skate (*Amblyraja radiata*) in the southern Gulf of St Lawrence: density-dependent habitat selection or response to environmental change? Fish. Oceanogr. 15: 166-182.

[2] Swain, D.P., Hurlbut, T., and Benoit, H.P. 2005. Changes in the abundance and size of skates in the southern Gulf of St. Lawrence, 1971-2002. J. Northwest Atl. Fish. Sci. 36: 19-30.

[3] Scott, W.B., and Scott, M.G. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731 p.

[4] Bourgdages, H., Archambault, D., Bernier, B., Fréchet, A., Gauthier, J., Grégoire, F., Lambert, J., and Savard, L. 2010. Preliminary results in the groundfish and shrimp multidisciplinary survey from August 2009 in the northern Gulf of St. Lawrence. DFO Can. Data Rep. of Fisheries and Aquatic Sci. xii + 72 p.

[5] DFO. 2004. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Can. Sci. Advis. Sec. Habitat Status Rep. 2004/002. 15 p.

[6] DFO. 2009. National Science Workshop: Review of Scientific Information on the Impacts of Seismic Sound on Fish, Invertebrates, and Marine Mammals Workshop II, 2008; 26-27 March 2008. DFO Can. Sci. Advis. Sec. Proceed. Ser. 008/032.

Appendix B689: Humpback Whale (*Megaptera novaeangliae*)

Scoping:

Activities/ stressors	Entanglement	Noise and Disturbance	Ship Strikes and Collisions	Industrial Effluents	Toxic algal blooms
Bottom Trawl	N	--	--	--	--
Gillnet	Y	--	--	--	--
Pot Gear	Y	--	--	--	--
Purse Seine	N	--	--	--	--
Vessel Traffic	--	Y	Y	--	--
Aquaculture	--	N	--	--	--
Seismic Surveys	--	Y	--	--	--
Industrial Activity	--	--	--	N	--
Submarine Cables	--	N	--	--	--
Ecotourism	--	N	N	--	--
Ballast Water Exchange	--	--	--	--	N

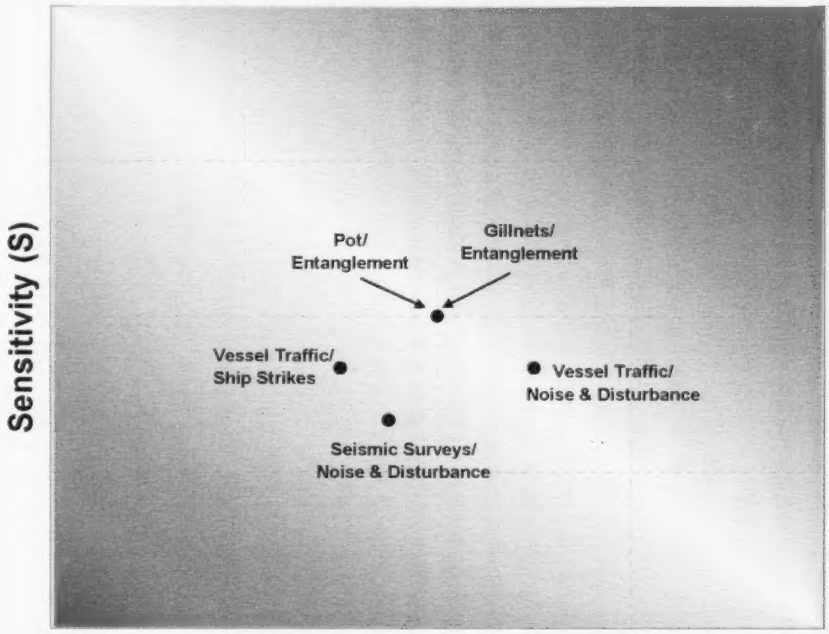
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Thirteen (13) activities/stressors were initially considered : Gillnet / Entanglement, Pot Gear / Entanglement, Bottom Trawl / Entanglement, Purse Seine / Entanglement, Vessel Traffic / Noise and Disturbance – Ship Strikes and Collisions, Aquaculture / Noise and Disturbance, Seismic Surveys / Noise and Disturbance, Industrial Activity / Industrial Effluents, Submarine Cables / Noise and Disturbance, Ecotourism / Noise and Disturbance – Ship Strikes and Collisions, Ballast Water Exchange / Toxic algal blooms.

Excluded (8) – More recent bottom trawling in the Estuary and Gulf of St. Lawrence targeted shrimp and redfish, but according to fisheries data, this activity has been limited since the mid-1990s and not considered a threat. Purse seines targeting capelin, herring and mackerel along near shore waters are unlikely to come in contact with larger cetaceans such as fin and humpbacks. Seabed preparation for submarine cables may result in whales avoiding the immediate area during operations. This activity seldom occurs in the Estuary and Gulf and avoidance behaviour is considered to be temporary and reversible in the short term. The potential for whales to come in contact with industrial effluent and contaminants is higher at the source. Due to the migratory nature of humpback whales and their tendency to frequent offshore areas, industrial effluent is not considered a major threat. High intensity sound devices may be used to deter seals from approaching salmon aquaculture sites in the southern Gulf; although, the level of salmon aquaculture is low compared to areas outside the Estuary and Gulf. It is uncertain what effect, if any, these devices have on whales that frequent the area. Seismic activity related to oil and gas exploration occurs periodically throughout the Estuary and Gulf, but it is uncertain to what degree this activity influences the behaviour of whales. Ballast water exchange is considered to contribute to an increase in toxic algae, although it is difficult to quantify because of its natural occurrence in the ocean. Ecotourism is common along some coastal areas of the Estuary and Gulf and humpbacks are known to be a desirable encounter because of their acrobatic displays. Interaction with ecotourism operations has not been considered an overall threat to the species in the Estuary and Gulf.

Included (5) – Gillnets and lobster, crab and whelk pots are considered the most problematic type of fishing gear associated with whale entanglement and are widely used throughout the Estuary and Gulf of St. Lawrence. Whale entanglements often go unreported and are also known to be associated with lost fishing gear (ghost nets). High levels of large vessel traffic occur throughout the Estuary and Gulf; the majority en route to the St. Lawrence seaway, but also to ports along all five provinces. Vessel collisions are considered a major source of whale mortality throughout global waters, although many collisions go unreported. Large vessels produce sound frequencies between 20 and 200 Hz and whales can adopt a variety of reactions to marine noise[10].

Relative Risk – Humpback Whale



Relative risk Profile: All the activities and stressors included in the vulnerability analysis had potential for direct physical contact with humpback whales in the Estuary and Gulf of St. Lawrence. Humpbacks are the most commonly reported species to be entangled in fishing gear such as gillnets and pot gear. It is thought that humpbacks are more susceptible because of their long flukes which accidentally come into contact with fishing gear as they migrate and feed. Next to entanglement, noise either from vessel traffic or seismic surveys may pose potential problems for humpbacks; mainly because, baleen whales use low frequency sounds to communicate and are considered sensitive to seismic bursts and other low frequency noise. Exposure to seismic and other sources of low level noise can result in displacement and/or migratory diversion in some marine mammals, but this effect is species, individual, and contextually-related. The ecological significance of such effects is unknown, but there are conditions under which the worst-case scenarios could be high (Fisheries and Ocean Canada, 2004). While they are one of the most abundant species, their numbers are relatively low - making them susceptible, as a group, to mortality from anthropogenic sources. However, their wide distribution both inside and outside the Estuary and Gulf may increase their resilience to perturbations overall.

Biology/Distribution: Humpback whales, one of the larger baleen whales, are highly migratory and are present in all oceans of the world[1]. They are often sighted in groups and can be easily identified by their long, usually white, flippers, their frequent acrobatic behaviour and tendency to approach vessels. Recent estimates suggest that the northwest Atlantic population appears to be growing[2]. A number of estimates of abundance exist for various areas in the northwest Atlantic including an estimate of approximately 11,000 individuals for the entire northwest Atlantic population and approximately 2,500 individuals for eastern Canadian waters, both of which are suspected to be negatively biased. The proportion of animals occurring in the Estuary and Gulf of St. Lawrence is unknown (LeSage et al 2007); however, aerial surveys during 1982 and again in 1995 and 1996 provided annual estimates of 100 individuals[3, 4]. Humpback whales were the fourth most frequently observed species (after harbour porpoise, minke whale and white-sided dolphin) during aerial surveys of the Estuary and Gulf[5] and were most abundant in the Belle-Isle/Esquiman Channel/Mecatina Plateau area in the northeastern Gulf. However, some were also observed to the northeast of Pointe-des-Monts and along western Newfoundland. Breeding and calving for the northwest Atlantic population occurs off the West Indies between December and April, followed by a northerly migration to major feeding areas in the northwest Atlantic including the Gulf of Maine, Estuary and Gulf of St. Lawrence, Newfoundland and Labrador, and western Greenland[6]. Humpback whales generally return to particular feeding aggregations[7], however, some switching with other feeding aggregations may occur[8], sometimes during the same year[9]. Humpback whales feed on a variety of schooling fish, but capelin is the prey of choice in the Estuary and Gulf and other Newfoundland and Labrador waters. Humpbacks are known to plunge through a school of fish with their mouths open, and often, one or more humpbacks may release air underwater while encircling a school of fish to concentrate the fish within a bubble net. This feeding method is unique to humpbacks. Female humpbacks become sexually mature at five years, and may calve every two years. Calves are weaned after one year, but may stay with their mothers up to two years.

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Appendix B70: Fin Whale (*Balanoptera physalus*)

Scoping:

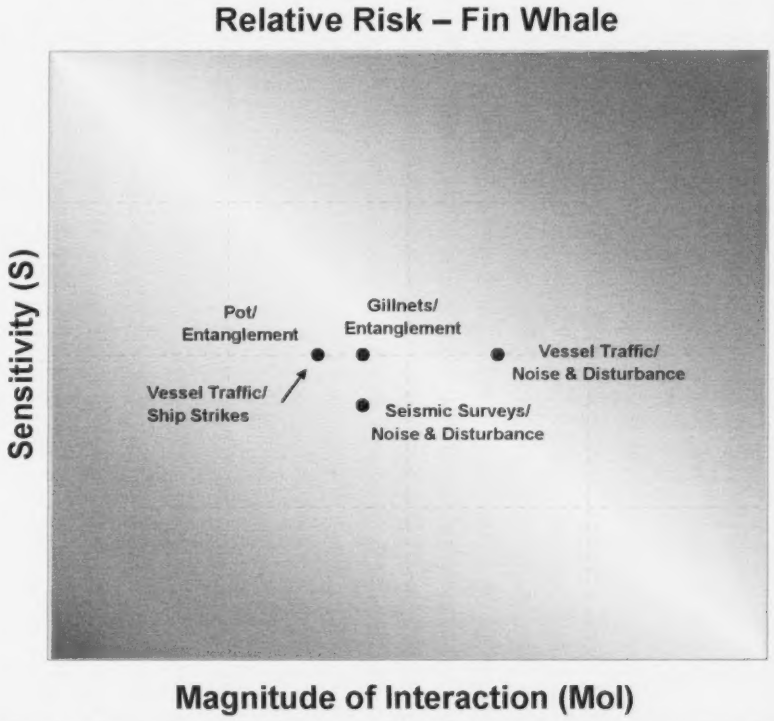
Activities/ stressors	Entanglement	Noise and Disturbance	Ship Strikes and Collision	Industrial Effluents	Toxic Algal Blooms
Bottom Trawl	N	--	--	--	--
Gillnet	Y	--	--	--	--
Pot	Y	--	--	--	--
Purse Seine	N	--	--	--	--
Vessel Traffic	--	Y	Y	--	--
Aquaculture	--	N	--	--	--
Seismic Surveys	--	Y	--	--	--
Industrial Activity	--	--	--	N	--
Submarine Cables	--	N	--	--	--
Ecotourism	--	N	N	--	--
Ballast Water Exchange	--	--	--	--	N
Scientific Research	--	N	--	--	--

Y = Activity/Stressor screened in;
N = Activity/Stressor screened out
-- = Irrelevant

Fourteen (14) activities/stressors were initially considered: Gillnet / Entanglement, Pot / Entanglement, Bottom Trawl / Entanglement, Purse Seine / Entanglement, Vessel Traffic / Noise and Disturbance – Ship Strikes and Collision, Aquaculture / Noise and Disturbance, Seismic Surveys / Noise and Disturbance, Industrial Activity / Industrial Effluents, Submarine Cables / Noise and Disturbance, Ecotourism / Noise and Disturbance – Ship Strikes and Collisions, Ballast Water Exchange / Toxic Algal Blooms, Scientific Research / Noise and Disturbance.

Excluded (9) – More recent bottom trawling in the Estuary and Gulf of St. Lawrence targeted shrimp and redfish, but according to fisheries data, this activity has been limited since the mid-1990s and not considered a threat. Purse seines targeting capelin, herring and mackerel along near shore waters are unlikely to come in contact with larger cetaceans such as fin and humpback whales. Seabed preparation for submarine cables may result in whales avoiding the immediate area during operations. This activity seldom occurs in the Estuary and Gulf and avoidance behaviour is considered to be temporary and reversible in the short term. The potential for whales to come in contact with industrial effluent and contaminants would be higher at the source. Due to the migratory nature of fin whales and their tendency to frequent offshore areas, industrial effluent is not considered a major threat. Previous studies have shown relatively low level of contaminants in fin whales that frequent the Estuary and Gulf[7]. High intensity sound devices may be used to deter seals from approaching salmon aquaculture sites in the southern Gulf; although, the level of salmon aquaculture is low compared to Bay of Fundy and other areas outside the Estuary and Gulf. It is uncertain what effect, if any, these devices have on whales that frequent the area. Seismic activity related to oil and gas exploration occurs periodically throughout the Estuary and Gulf, but it is uncertain to what degree this activity influences the behaviour of whales. Activities associated with scientific research vessels, whether direct or indirect, are regulated to minimize stress on whales and other cetaceans. Ballast water exchange is considered to contribute to an increase in toxic algae, although it is difficult to quantify because of its natural occurrence in the ocean. Ecotourism is common along some coastal areas of the Estuary and Gulf. Fin whales are known to allow boats to approach and they may remain in the same area for several days; however, negative interaction with ecotourism has not been considered an issue in the Gulf and Estuary.

Included (5) – Gillnets and lobster, crab and whelk pots are considered the most problematic type of fishing gear associated with whale entanglement and are widely used throughout the Estuary and Gulf of St. Lawrence. Whale entanglements often go unreported and are also known to be associated with lost fishing gear (ghost nets). High levels of large vessel traffic occur throughout the Estuary and Gulf of St. Lawrence; the majority en route to the St. Lawrence seaway, but also to ports along all five provinces. Vessel collisions are considered a major source of whale mortality throughout global waters, although many collisions go unreported. Large vessels produce sound frequencies between 20 and 200 Hz and whales can adopt a variety of reactions to marine noise[8].



Relative risk Profile: All activities and stressors included in the vulnerability analysis have potential for direct physical contact with fin whales in the Estuary and Gulf of St. Lawrence. They appear to be most vulnerable to vessel traffic noise and entanglement in gillnets and pot gear; however, their large size often enables them to break free. Baleen whales use low frequency sounds to communicate and are considered sensitive to seismic bursts and other low frequency noise. Exposure to seismic and other sources of low level noise can result in displacement and/or migratory diversion in some marine mammals, but this effect is species, individual, and contextually-related. The ecological significance of such effects is unknown, but there are conditions under which the worst-case scenarios could be high[9]. While numbers appears to be increasing in some areas, the species is considered to be depleted at a global level. However its global distribution may increase its resilience to perturbations overall. The current abundance and level of depletion compared with pre-whaling numbers are uncertain. The whales face a number of current threats including ship strikes and entanglement in fishing gear, but none is believed to seriously threatening the population.

Appendix B70: Fin Whale (*Balanoptera physalus*) (continued)

Biology/Distribution: Fin whales are the second largest animal on the planet after blue whale, and are characterized by a streamlined body and swimming speeds up to thirty kilometers per hour. They occur in most oceans of the world, usually in temperate or polar regions and less common in tropical waters. Fin whales are associated with low surface temperatures and oceanic fronts during summer months. The north Atlantic population ranges from the Gulf of Mexico to the Arctic pack ice and can be found along inshore waters to well beyond the shelf break[1]. Migration patterns are not well understood, and little is known about mating and calving areas[2]. Next to humpbacks, fin whales are the most numerous of the large whales in Canadian waters. They are regular visitors to both the Estuary and Gulf of St. Lawrence and can be seen regularly during the ice-free period along the Laurentian Channel up to Tadoussac, and sometimes further west[3]. Aerial surveys of the Estuary and Gulf of St. Lawrence provide annual estimates of a few hundred fin whales, mostly north of the Îles-de-la-Madeleine, along the shelves or channel margins[3]; although, they are likely to occur regularly throughout the entire Estuary and Gulf[4]. Global population estimates are in the tens of thousands. In the Estuary and Gulf, feeding tends to be concentrated along the margins of the Laurentian Channel and the north shore shelf where krill and schooling fish such as capelin, herring and lance tend to be the food of preference[5, 6]. Fin whales become sexually mature at about seven to ten years of age, and generally have a calf every two to three years. The Atlantic population of fin whales is listed as a species of special concern under the Species At Risk Act (SARA). The most significant direct threats are ship strikes and entanglement in fishing gear. Fin whales may also be negatively affected by ecological interactions associated with fisheries but these have not been clearly specified or validated. Similarly, human-generated underwater noise may degrade habitat and impair communication of fin whales, but details are uncertain. It is uncertain what effect chemical pollution and climate change has on fin whale populations[1].

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Appendix B691: Redfish (3 species) (*Sebastes* spp.)

Scoping:

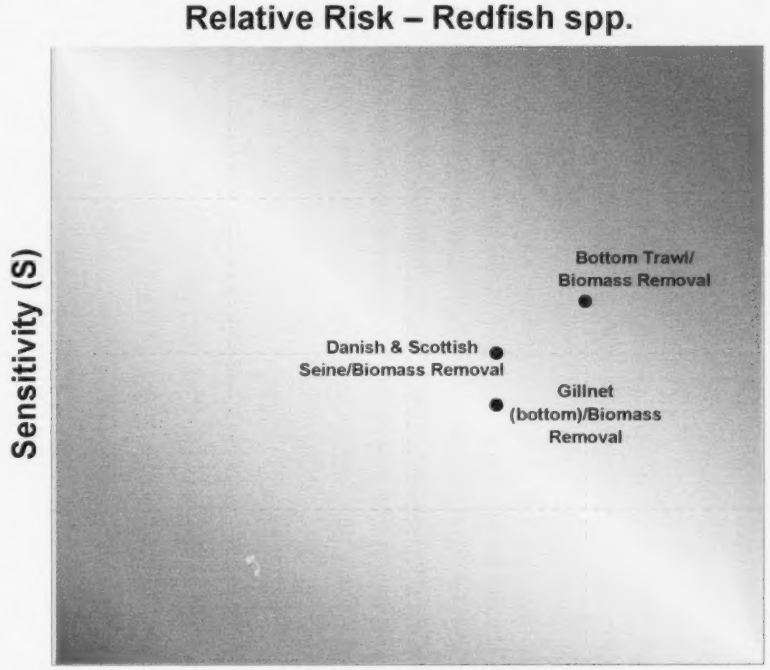
Activities/ stressors	Biomass Removal	Habitat Alteration
Bottom Trawl (Otter)	Y	N
Scallop Dredge	N	--
Gillnets	Y	--
Danish and Scottish Seine	Y	--
Longlines	N	--
Midwater Trawl	N	--
Shrimp Trawl	N	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Eight (8) activities/stressors were considered as potentially affecting redfish. These include Biomass Removal by fishing activities using Otter Trawl (bottom), Scallop Dredge, Gillnets (bottom), Danish and Scottish Seine, Longlines, Midwater Trawl, Shrimp Trawl, and Habitat Alteration from Bottom Trawling. Disturbance from Seismic Noise was also considered. A variety of human activities / stressors were considered (e.g. Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluent, Dredging / Habitat Alteration and Human Activity-Induced Climate Change), however only those deemed to have the potential for significant effects on the species were included in the scope of the analysis.

Excluded – Longlines and shrimp trawl gear were screened out because by catch of redfish is negligible. Since the shrimp fishery began using Nordmore Grates at the opening of the trawl nets (1993-94), the by-catch of groundfish, including redfish has basically been eliminated however there is still a by-catch of small juvenile fish including redfish which is not accounted for in the official landing statistics. This by-catch was not considered significant in comparison to other species caught in the shrimp fishery (pers. comm. Johanne Gauthier, DFO, Québec Region). Scallop dredge has a potential for by-catch of groundfish but this activity occurs in shallower areas outside of the redfish habitat. Mid-water trawl has not been in use in the Estuary and Gulf since 1990's. Potential for habitat alteration exists with all bottom gears especially if spawning areas are present but in this case redfish are live bearers and larvae are pelagic. Disturbance to eggs and larvae from seismic noise is not considered a treat.

Included – Otter trawl (bottom) is the primary gear used in the redfish index fishery and some directed fishing with Scottish and Danish seines does occur as well. By catch of redfish also occurs in bottom gillnet which is taken into consideration.



Relative risk profile: In the GSL, there is a 25-75% overlap of the species distribution with the distribution of bottom trawls and a 5-25% overlap of the species distribution with the distribution of Danish/Scottish seines and gillnets. These gear types are designed to capture demersal species, thus full contact is expected when the gears coincide with the species. Taking into account the temporal presence of redfish in the GSL and the months in which fish harvesters use bottom trawls, seines, and bottom gillnets, the overlap between the occurrence of redfish and these gears would be greater than 95%. According to the logbook data, the intensity of bottom trawling relative to the species distribution is moderate, while seine and bottom gillnet intensity relative to the species distribution are each considered to be unlikely (5-25%).

Redfish species are long-lived and late-maturing, and highly vulnerable to mortality from human activities. Recruitment is episodic, with strong year-classes only occurring every 5-12 years. Directed fishing and incidental harvest in fisheries for other species (by-catch) are the main known threats. Harvesting in parts of this population (Estuary and Gulf of St. Lawrence) is currently limited to an index fishery (COSEWIC 2010). Given these issues and considering the landings by these gear types, the overall impact of bottom trawling on the species and their habitat is expected to be in the medium range, while the impact of seines is expected to be low and bottom gillnets are expected to be negligible. Redfish function as both predator and prey in the ecosystem. The loss or significant decline of the species would represent a medium disruption to the ecosystem function. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2010) has listed the Estuary and Gulf of St. Lawrence population of *S. mentella* as endangered, while the Atlantic population of *S. fasciatus* has been listed as threatened. Sentinel trawl surveys indicate a decreasing trend in redfish biomass over the last 10 years. Given that redfish are slow growing and long-lived species and given that the population has not rebounded since the 15 year moratorium, we would consider the species to have low resilience and very high sensitivity to fishing activities.

Biology/Distribution: Two species of redfish are common to the Estuary and Gulf of St. Lawrence. These species inhabit cool waters near the bottom along the slopes of banks and deep channels. *Sebastes fasciatus* occurs in shallower waters (150-300 m) and *S. mentella* occupies depths between 350 and 500 m. Studies have shown that redfish undertake diel vertical migrations during the night to following prey[1].

Redfish are slow-growing, long-lived species. Redfish take 7 to 8 years to reach the fishery's minimum allowable size (22 cm) (DFO 2010). Males of either species mature earlier and at a smaller size than females and *Sebastes fasciatus* of either sex mature earlier and at a smaller size than *S. mentella*[1]. Fertilization in redfish is internal and females bear live young. Mating takes place in the fall and larvae are released in spring with *Sebastes mentella* releasing its larvae 3 to 4 weeks earlier than *S. fasciatus* in the Estuary and Gulf of St. Lawrence[1].

The directed redfish fishery began in the Estuary and Gulf of St. Lawrence in the late fifties[1]. A moratorium was imposed in 1995. The current index fishery occurs from mid-June to the end of October annually. In 2009, the survey index of spawning stock biomass of *S. fasciatus* was estimated at 146,400 t and *S. mentella* was estimated at 115,400 t[1].

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has listed the Estuary and Gulf of St. Lawrence population of *S. mentella* as endangered, while the Atlantic population of *S. fasciatus* has been listed as threatened. Both species were last examined in April 2010[2].

When redfish biomass was high during the mid-1980s, redfish were among the main prey and predators in the northern Gulf ecosystem[3]. This role has diminished with the decreasing abundance of redfish. According to Savenkoff *et al.*[3], predation has dominated total mortality of redfish over the last three decades. Predation of redfish has shifted during this period with large cod as the main predator in the mid-1980s, harp seals and skates from the mid-1980s to mid-1990s and from the mid-1990s to the early 2000s harp seals were the main predator of redfish.

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[3] Savenkoff, C., Morin, B., Chabot, D., and Castonguay, M. 2006. Main prey and predators of redfish (*Sebastes* spp.) in the northern Gulf of St. Lawrence during the mid-1980s, mid-1990s, and early 2000s. DFO Can. Tech. Rep. of Fish. and Aquat. Sci. vi + 23 p.

Johanne Gauthier. Personal Communication. Fisheries and Oceans Canada, Biologist, Gulf Region. October 6, 2010.

Appendix B702: American Lobster (*Homarus americanus*)

Scoping:

Activities/ stressors	Biomass Removal	Habitat Alteration	Ghost Nets	Oil Spills and Pollution	Industrial Effluents	Noise and Disturbance	Temperature and Salinity Change
Bottom Trawl	–	Y	–	–	–	–	–
Scallop Dredge	–	Y	–	–	–	–	–
Gillnets	–	–	Y	–	–	–	–
Longline	–	N	–	–	–	–	–
Lobster Pots	Y		Y	–	–	–	–
Dredging	–	Y	–	–	–	–	–
Vessel Traffic	–	–	–	Y	–	–	–
Industrial Activities	–	–	–	–	Y	–	–
Seismic Surveys	–	–	–	–	–	N	–
Human Activity Induced Climatic Change	–	–	–	–	–	–	N

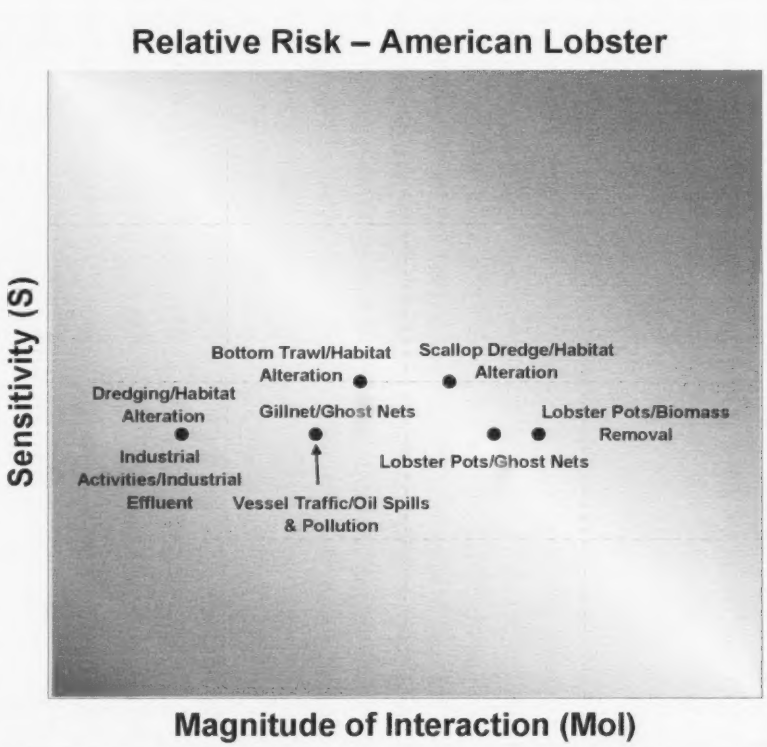
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Eleven (11) activities / stressors were considered in the American lobster vulnerability analysis: Bottom Trawl / Habitat Alteration, Scallop Dredge / Habitat Alteration, Gillnets / Ghost Nets, Longline / Habitat Alteration, Lobster Pots / Biomass Removal – Ghost Nets, Dredging / Habitat Alteration, Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluents, Seismic Surveys / Noise and Disturbance, Human Activity Induced Climatic Change / Temperature and Salinity Change.

Excluded (3) – The probability of spatial overlap between lobster distributions and longline fishing is negligible. Given the low probability that seismic surveys will commence in the Estuary and Gulf of St. Lawrence within the next ten years and the uncertain impacts on this ecosystem, this activity was not retained.

The stressors associated with human-induced climate change have not been retained in this assessment. According to Peter Galbraith (pers. comm., Fisheries and Oceans Canada), the time series data is not sufficient to detect clear trends and the inter-annual variations cannot be adequately explained. Though the various stressors associated with human-induced climate change are likely to affect this ecosystem component in the future, none of these are expected to lead to significant impacts over the next decade.

Included (8) – Mobile gear such as bottom trawl and scallop dredges are known to cause damage to benthic communities. The lobster is a target species for trap fishing in the Estuary and Gulf of St. Lawrence. Gillnets and ghost traps are problematic issues, although their numbers are not known. The St. Lawrence Seaway is a major maritime route, which increases the potential for oil spills and pollution. A substantial amount of industrial activity (industrial effluents) such as mining (extraction and refining) and pulp and paper occurs along the shores of the St. Lawrence River.



Relative risk profile: According to the determined vulnerability, the lobster is a highly resilient species that is not very sensitive to disturbances. On the other hand, habitat changes caused by bottom trawling and scallop dredging as well as oil spills from transport vessels can wield a considerable impact on this species if they coincide in time and space.

Trap fishing has had the greatest impact on the lobster so far, although it does not appear to be problematic at this point. Ghost fishing with abandoned traps and gillnets is an identified threat, but there are no data with which to assess the real impact on lobster populations. Finally, according to our analysis, neither industrial effluents nor dredging would have a major impact on this species.

Appendix B72: American Lobster (*Homarus americanus*) (continued)

Biology/Distribution: The American lobster (*Homarus americanus* L.) is found along the west coast of the Atlantic Ocean from Labrador to Cape Hatteras[1]. It is one of the largest and most long-lived marine crustaceans, with some individuals living to 50 years of age.

The female reproductive cycle lasts for about two years, with alternating years of egg laying and molting. Mating takes place just after the female has molted, after which the female produces and carries the eggs inside her body for the next twelve months. The eggs are then expelled and fertilized by the sperm that was stored there after mating. The females carry and protect their eggs for another nine to twelve months before hatching. Depending on their size, lobsters may produce tens of thousands of eggs[1, 2].

Commercially exploited lobsters are generally found at depths of less than 35 metres. The American lobster prefers a rocky sea bottom that provides shelter, but it is also found in waters with a sandy, gravelly or silty bottom[1]. The lobster lives in water temperatures that vary from 1.5 to 24°C. In summer it moves closer to the shoreline to benefit from the higher temperatures, and in winter it returns to deeper, more sheltered waters to protect itself from ice, intense cold and storms (MPO, Online http://www.dfo-mpo.gc.ca/Science/publications/uww-msm/articles/americanlobster-homarddamerique-fra.html).

Because the adult lobster has few natural predators, it is a dominant species in its own territory [3]. The lobster is an important predator of rock crab, although it also consumes polychaetes, molluscs, and echinoderms[2]. As an opportunist, it can also feed on fish carcasses (e.g., capelin) when available[4].

The minimum commercial size (82 mm) is attained at about eight years of age, when the lobsters have molted about 16 times since their benthic establishment. The age of entry into commercial fishing may be higher in more northern sectors[5].

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[4]Christian, J.R., Grant, C. G.J., Meade, J.D., and Noble, L.D. 2010. Habitat Requirements and Life History Characteristics of Selected Marine Invertebrate Species Occurring in the Newfoundland and Labrador Region. Can. Man. Rep. Fish. Aqua. sci. 2925: 207 p.

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Expert consulted: Louise Gendron. MPO-DFO Mont-Joli – Québec

Appendix B713: Atlantic white-sided dolphin (*Lagenorhynchus acutus*)

Scoping:

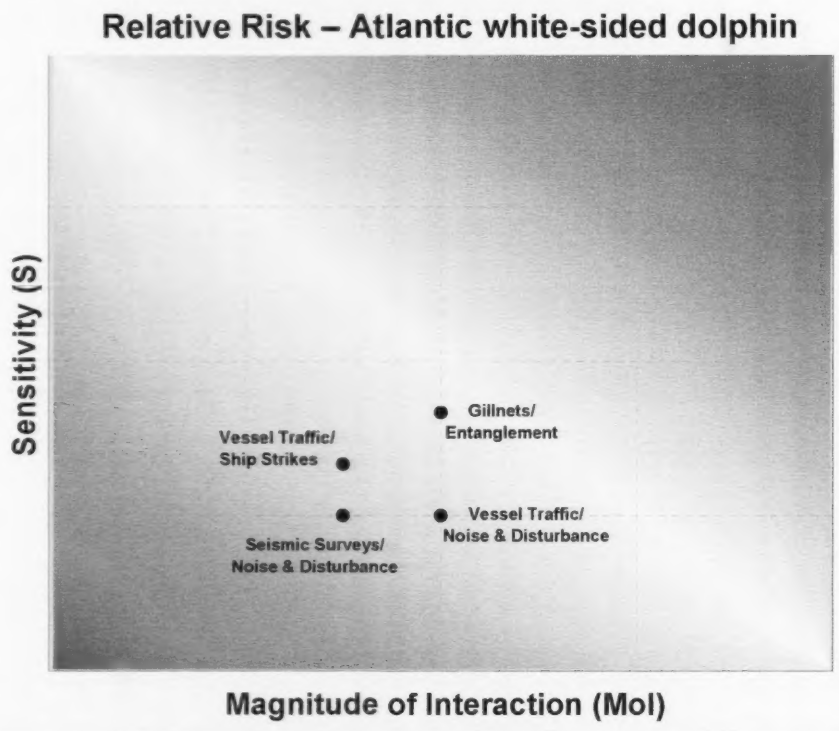
Activities/ stressors	Entanglement	Noise and Disturbance	Oil Spills and Pollution	Ship Strikes and Collisions	Persistent Organic Pollutants and Chemical Contaminants
Gillnets	Y	–	–	–	–
Pot Gear	N	–	–	–	–
Industrial Activities	–	–	–	–	N
Vessel Traffic	–	Y	N	Y	–
Seismic Surveys	–	Y	–	–	–
Ecotourism	–	N		N	–

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Nine (9) activities/stressors were initially identified: Gillnets / Entanglement, Pot Gear / Entanglement, Industrial Activities / Persistent Organic Pollutants and Chemical Contaminants, Vessel Traffic / Noise and Disturbance – Oil Spills and Pollution – Ship Strikes and Collisions, Seismic Surveys / Noise and Disturbance, Ecotourism / Noise and Disturbance – Ship Strikes and Collisions. Most of these were excluded either because of limited activity in the area or because their location and timing were unlikely to coincide with presence of the species.

Excluded (5) – Industrial activities were excluded because white-sided dolphins are highly migratory and thus would avoid prolonged exposure to any potential impacts of persistent organic pollutants, contaminants or industrial wastewater. Pot gear entanglement is usually considered more of an issue for larger whale species as is ecotourism (noise and ship strikes) in the Estuary of the St. Lawrence.

Included (4) – Gillnets are a known source of entanglement for many marine mammals and it is reportedly the younger and smaller individuals that are most at risk. There have been reports of the Atlantic white-sided dolphin becoming entangled in offshore fishing gear along Newfoundland, but the impact on the overall population is unknown[1]. Seismic surveys take place in many areas of the Estuary and Gulf. Observers on vessels operating off the United Kingdom from 1997–2000 reported dolphins of various species exposed to seismic pulse often showed more evidence of avoidance of operating air gun arrays than has been reported previously for small Odontocetes. Sighting rates of white-sided dolphins, white-beaked dolphins, *Lagenorhynchus* spp., and all small Odontocetes combined were significantly lower during periods of shooting[3]. Lawson *et al* (2000) documented temporary threshold shifts (TTS) for bottlenose dolphins and concluded that dolphins have to be within 100 m of the air gun to exceed their TTS[4]. In the Estuary and Gulf, more recent seismic surveys have been carried out off western Newfoundland and the Cape Breton Trough. Vessel traffic is extensive in the Estuary and Gulf of St. Lawrence resulting in high potential for increased noise level and ship strikes.



Relative risk profile: All the activities and stressors included in the vulnerability analysis have potential for direct physical contact with Atlantic white-sided dolphin in the Estuary and Gulf of St. Lawrence. However, the level of vulnerability to impact is considered to be low overall. This was mainly because as a species, white-sided dolphins are highly migratory and the numbers entering the Estuary and Gulf vary annually, thus limiting the overall effects of perturbations to individual animals and/or pod behaviour rather than the species as a whole. While information regarding population estimates is limited, their overall abundance is not of concern at this time.

Biology/Distribution: Atlantic white-sided dolphins were the third most frequently observed species (after harbour porpoise and minke whale) in aerial surveys of the Estuary and Gulf of St. Lawrence[1]. Concentrations of Atlantic white-sided dolphins were generally observed in areas of relatively deep water such as the Esquiman Channel, the Laurentian Channel near St Georges Bay in southwestern Newfoundland, the entrance of Gaspé Bay, the area to the northeast of Pointe-des-Monts, and the deeper waters of the Jacques-Cartier Strait. One exception to this pattern was a concentration of white-sided dolphins, which was observed in the shallower waters of the Strait of Belle-Isle/Mecatina Plateau. The Atlantic-white-sided dolphin is slightly larger than most other oceanic dolphins. It is just over a meter in length at birth, growing to about 2.8 m (males) and 2.5 m (females) at maturity. It is identifiable by an elongated white patch along each side, with a distinctive mustard-coloured patch near the tail. It is often mistaken for the white-beaked dolphin. The Atlantic white-sided dolphin has a lifespan of 25 years and generally calves every two to three years. Calving occurs during summer, followed by a nursing period of eighteen months. The Atlantic white-sided dolphin travels in pods, feeding on schooling fish such as herring, mackerel and squid; often accompanying fin, humpback and pilot whales and white-beaked dolphins[2]. Feeding occurs along the continental shelf, but also periodically along inshore waters. While surveys from Nova Scotia to Virginia estimate 30,000 within this area, there are no population estimates for Newfoundland and Labrador waters, and total population is unknown. Although, surveys suggest that they number in the tens of thousands[1]. Ariel surveys in the Estuary and Gulf during late August 1995 provided an index estimate (not corrected for visibility biases) of 12,000 individuals, whereas the next year, approximately 500 individuals were observed a month earlier, suggesting large variations in abundance between years and seasons. Groups of fifty to sixty are often sighted in inshore waters, while groups of more than 1000 have been sighted offshore. Pods have been sighted along the Laurentian Channel and Estuary, the Esquiman Channel, and inshore waters along western Newfoundland.

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[3] Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters 1998-2000. JNCC Report 323. Joint Nature Conservancy, Aberdeen, Scotland. 43 p.

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Appendix B724: Harbour porpoise (*Phocoena phocoena*)

Scoping:

Activities/ stressors	Entanglement	Noise and Disturbance	Noise and Disturbance	Oil Spills and Pollution	Ship Strikes and Collisions	Persistent Organic Pollutants and Chemical Contamination
Gillnets	Y	–	–	–	–	–
Aquaculture	–	N	–	–	–	–
Vessel Traffic	–	–	Y	N	Y	–
Seismic Surveys	–	–	Y	–	–	–
Industrial Activities	–	–	–	–	–	N
Ecotourism	–	–	N	–	N	–

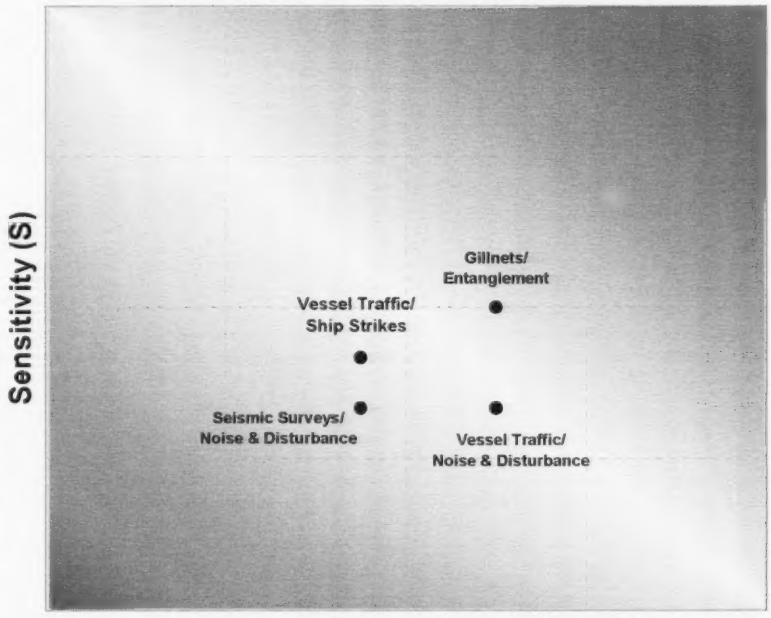
Y = Activity/Stressor screened in
N = Activity/Stressor screened out
– = Irrelevant

Nine (9) activities/stressors were initially considered: Gillnets / Entanglement, Aquaculture / Noise and Disturbance, Vessel Traffic / Noise and Disturbance – Oil Spills and Pollution – Ship Strikes and Collisions, Seismic Surveys / Noise and Disturbance, Industrial Activities / Persistent Organic Pollutants and Chemical Contamination, Ecotourism / Noise and Disturbance – Ship Strikes and Collisions. Most of these were excluded either because of limited activity in the area or because their location and timing were unlikely to coincide with presence of harbour porpoises.

Excluded (5) – Sound devices commonly used to deter predators from salmon aquaculture sites may be a concern for porpoises in the Bay of Fundy and possibly other areas. However, this does not appear to be a major threat in the Estuary and Gulf of St. Lawrence, where shellfish production is the focus of the aquaculture industry and very little finfish aquaculture occurs. While industrial pollution in areas such as the Estuary is considered to be a potential threat to the resident beluga population, specific effects on the harbour porpoise population are unknown, as they are much more widely distributed throughout the Estuary and Gulf. For harbour porpoise, polychlorinated biphenyls (PCBs) and chlorinated bornanes are the dominant contaminants and these are generally found to increase in concentration in a north to south gradient, with porpoises in the Bay of Fundy and Gulf of Maine exhibiting the highest levels. Pot gear entanglement and ecotourism (noise & ship strikes) are considered to be more of an issue for larger whale species and less so for other cetaceans.

Included (4) – Entanglement in fishing nets has been described as the most significant human-induced threat to porpoises[10]. In the Estuary and Gulf of St. Lawrence, by-catch declined, perhaps by 24-63% from the late 1980s to early 2000s, but remains "non-negligible" (low thousands)[11]. Harbour porpoises tend to stay away from moving ships and the sounds of outboard motors. However, they do rest at the surface for extended period of time and may be prone to vessel strikes. Activities such as vessel traffic (noise) and seismic exploration could also have the effect of deterring animals from preferred habitat for feeding and/or calving areas, or within migration corridors.

Relative Risk – Harbour Porpoise



Relative risk profile: All activities and stressors included in the vulnerability analysis had potential for direct physical contact with harbour porpoises in the Estuary and Gulf of St. Lawrence. Harbour porpoises emit sounds to find fish and navigate, but their ability to detect mono-filament nets is low in relation to their swimming speed. Therefore, harbour porpoises (as well as some other marine mammals) are highly prone to entanglement in fishing gear, and gillnets are known to be one of the most problematic types of fishing gear for cetacean entanglement[12, 13, and 14]. An evaluation (using questionnaires) of the Estuary and Gulf gillnet fishery (commercial; commercial with at sea observers on board; and sentinel fisheries) from 2000 to 2002 provided data that predicts incidental mortality levels for harbour porpoises at greater than 2000 annually[7]. This species occurs throughout the Estuary and Gulf and its presence coincides with the timing of this activity, increasing the likelihood of coming in contact with fishing gear. Harbour porpoises are more solitary than white-sided dolphins and have a tendency to avoid noise such as operating airgun arrays[15] or vessel traffic. This means that they may be easily deterred from preferred habitat by activities such as vessel traffic and seismic surveys. Sighting rates of white-sided dolphins, white-beaked dolphins, *Lagenorhynchus* spp., and all small odontocetes combined were significantly lower during periods of shooting[15]. Seismic airgun arrays produce high intensity sounds at frequencies in the hearing range of harbour porpoises[11]. In the Estuary and Gulf, more recent seismic surveys have been carried out off western Newfoundland and the Cape Breton Trough. However, there have been no studies of the effects of these activities on harbour porpoises in the Estuary and Gulf. The tendency of harbour porpoises to spend extended periods at the surface also exposes them to injury or death from ship strikes.

Appendix B74: Harbour porpoise (*Phocoena phocoena*) (continued)

Biology/Distribution: Harbour porpoises are widely distributed over continental shelves, but also found in deeper waters[1]. The Estuary and Gulf of St. Lawrence population is one of three populations in the northwest Atlantic[2]. While little is known about migration patterns, it is expected that they move to open water outside the Estuary and Gulf during periods of extensive ice cover. Harbour porpoises were the most frequently observed species in the Estuary and Gulf[3] during aerial surveys in 1995 and 1996[4], and again in 2003[5]. In addition to aerial surveys, vessel surveys conducted from May to November 2002[6]; as well as reports of incidental mortalities in the gillnet fishery in 2000-2002[7] suggest that the harbour porpoise is ubiquitous throughout the Estuary and Gulf. However, they were detected in larger numbers in the northern part of the Estuary and Gulf, with encounter rates being particularly high on the Banc Parent just west of Anticosti Island, at the entrance of Gaspé Bay, in the Jacques-Cartier Strait and eastward onto the north shore shelf, and along the western shelf of Newfoundland from Bay of Islands and northward. Estimates of 12,100 and 21,720 individuals were observed during 1995 and 1996 surveys respectively; although it is speculated that between 36,000 and 125,000 harbour porpoises frequent the Estuary and Gulf during summer[4]. Harbour porpoise is among the smallest cetaceans with body lengths usually not greater than 1.7m. They can live up to 20 years. Females reach sexual maturity at age three and generally give birth every year[8]. They generally feed independently and are most often sighted as single animals, but may also form small groups of up to five. In the Estuary and Gulf, they feed mainly on capelin and Atlantic herring, but also on redfish, mackerel, cod, sand lance and squid[9]. They are preyed upon by killer whales and great white sharks that have a range that includes the Estuary and Gulf[8]. Harbour porpoise has been assessed as endangered by COSEWIC[1] and is under consideration as a species of special concern under the Species at Risk Act (SARA).

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[4] Kingsley, M.C.S., and Reeves, R.R. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76:1529-1550.

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[6] Gosselin, J-F. 2003. Cetacean surveys in the Gulf of St. Lawrence. p. 27-28 *in* J.D. Neilson (ed.), Proceedings of the National Marine Mammal Peer Review Committee. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2003/022.

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[15] Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters 1998-2000. JNCC Report 323. Joint Nature Conservancy, Aberdeen , Scotland. 43 p.

Appendix B735: White Hake (*Urophycis tenuis*)

Scoping:

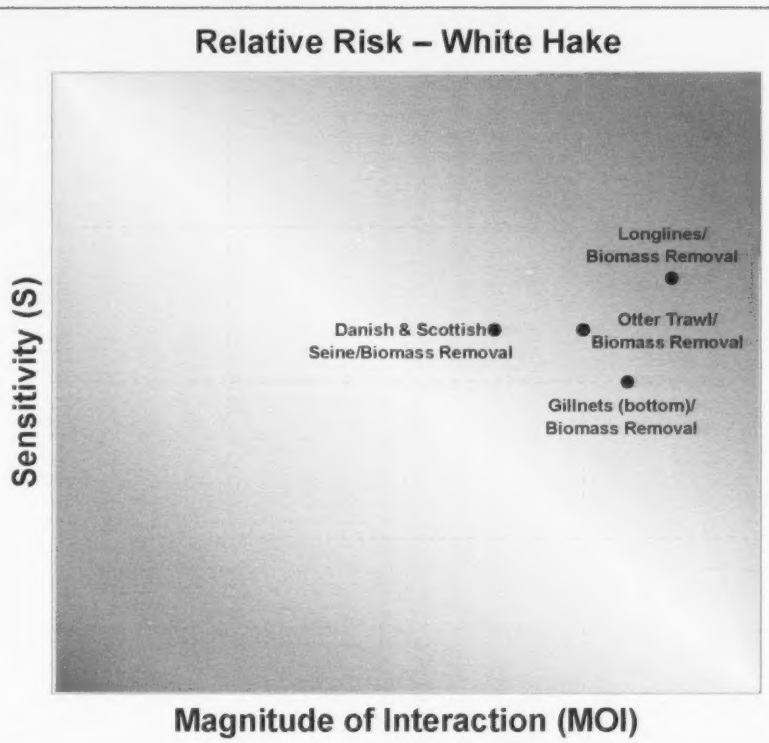
Activities/ stressors	Biomass Removal	Habitat Alteration	Ghost Nets	Noise and disturbance	Oil Spills and Pollution	Industrial Effluent
Bottom Trawl	Y	N	--	--	--	--
Scallop Dredge	N	--	--	--	--	--
Gillnets	Y	--	N	--	--	--
Danish and Scottish Seine	Y	--	--	--	--	--
Longlines	Y	--	--	--	--	--
Handlines	N	--	--	--	--	--
Mid-water Trawl	N	--	--	--	--	--
Shrimp Trawl	N	--	--	--	--	--
Seismic Surveys	--	--	--	N	--	--

Y = Activity/Stressor screened in
N = Activity/Stressor screened out
-- = Irrelevant

Eleven (11) activities / stressors were initially considered: Bottom Trawl / Biomass Removal – Habitat Alteration, Scallop Dredge / Biomass Removal, Gillnets (bottom) / Biomass Removal – Ghost Nets, Danish and Scottish Seine, Biomass Removal, Longlines / Biomass Removal, Handlines / Biomass Removal, Mid-water Trawl / Biomass Removal, Shrimp Trawl / Biomass Removal, Seismic Surveys / Noise and Disturbance, Vessel Traffic / Oil Spills and Pollution, Industrial Activities / Industrial Effluent, Dredging / Habitat Alteration, and Human Activity-Induced Climate Change), however only those deemed to have the potential for significant effects on the species were included in the scope of the analysis.

Excluded (7) – Given the location, nature, and reduced intensity of bottom trawls and given that disruptions to the ocean floor would only provide very short-term impacts (i.e., food sources may be disturbed within the reaches of the trawl), it is not believed that habitat alteration by bottom trawl will significantly impact this species. Scallop drags have the potential to capture groundfish by-catch, but no landings of white hake by-catch have been reported. Mid-water trawl has not been in use in the Estuary and Gulf since 1990's and since the shrimp fishery began using Nordmore Grates at the opening of the trawl nets (late 90's), the by-catch of groundfish has basically been eliminated. Handlines do have a by-catch of white hake but is very small compared to other gears and was excluded. Ghost nets represent the same basic threat to fish as their deliberately set counterparts however in any given area they are not as numerous as deliberately set fishing gear. As time passes they become less and less efficient at fishing since they become fouled and floats either are degraded or otherwise lose their ability to suspend the net off bottom. There is no conclusive evidence to support the concern that noise and pressure changes associated with conventional seismic surveys impact finfish[3, 4].

Included (4) – Four (4) fishing gears were included in the vulnerability profile which included gears either used directly to capture white hake in the sentinel fishery or gears which had a by-catch of white hake. Bottom trawls, Danish/Scottish seines and longlines are used in the sentinel fishery for white hake and by-catch of hake are likely to occur from other fisheries as well. Landing of white hake also occur as by-catch in gillnets.



Relative risk profile: White hake has a high sensitivity to biomass removal due it is low resilience. All the stressors considered in the vulnerability analysis had some amount of biomass removal through by-catch or the sentinel fishery. In the vulnerability profile white hake is most sensitive to biomass removal by longlines. The species distribution has a high overlap with the distribution of longline fishing effort (75-95%). There is a 25-75% overlap with gillnets and bottom trawls while Danish/Scottish seines have the least overlap (5-25%). Qualitative risk assessment fishing gear assigns contact at greater than 75% for non-commercial by catch of bony fishes for all gears that target groundfish. All gears have the potential to be in use between April–November/December and since white hake are found within GSL throughout the year, the overlap between the duration of the activity and the species presence in the Estuary and Gulf is considered greater than 95%. Intensity varies by gear type but generally longline and bottom gillnets have a higher intensity (75-95%) than the other two gears.

Longlines are the primary means of removal of white hake with relatively high acute and chronic impacts on the species. Both seines and bottom trawls are in the medium range, while bottom gillnets have the least impact. Similar to Atlantic cod, white hake function as both predator and prey in the ecosystem. The loss or significant decline of the species would represent a medium disruption to the ecosystem function. The white hake fishery has been under a moratorium since 1995, the population has not rebounded sufficiently to open the fishery. The indices of abundance and biomass were the lowest observed since the directed fishery was closed in 1995[2]. Given these factors, the resilience of this species is considered low and is very highly sensitive to biomass removal by fishing activities.

Appendix B75: White Hake (*Urophycis tenuis*) (continued)

Biology/Distribution: White hake is an eurythermal and eurybathic fish (tolerant of all temperatures and depths) that inhabits the continental shelf and slope; juveniles occur in estuaries and nearshore waters. The eggs, larvae, and early juveniles are pelagic; older juveniles and adults are demersal. Demersal juveniles feed primarily on polychaetes, shrimps, and other crustaceans, but adults feed on fish, including juveniles of their own species, shrimps and other crustaceans[1]. White hake are distributed along the periphery of the entire southern Gulf of St. Lawrence (GSL), along the coast or along the southern fringe of the Laurentian Channel and tend to avoid the vast open spaces of the Magdalen Shallows.

There is no directed fishery for white hake in the southern or northern GSL (NAFO 4RST) because the fishery has been under moratorium since 1995. There is however a sentinel survey using longlines and mobile gear (bottom trawl and seines). White hake is also part of the by-catch in other groundfish fisheries, especially those targeting cod, winter flounder, and redfish. Landings in the white hake fishery since the moratorium have ranged in magnitude from 399 t in 1999 to 36 t in 2003. In 2004, the reported landings were 55 t of which 15.5 t was taken by the sentinel survey[2].

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